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Board of Patent Appeals and Interferences
Commissioner for Patents
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By: William J. Daley
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BRIEF ON APPEAL

Sir:

This is and appeal from the final rejection of May 4, 2005 of claims 1, 4, 5, 7 11 and 13-15.

BRIEF ON APPEAL FEE

Authorization to charge Deposit Account No. 04-1105 for $250.00 is provided herewith. However, if for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, the Commissioner is hereby authorized and requested to charge Deposit Account No. 04-1105.

REAL PARTY IN INTEREST

The real party in interest is Tenebreax Corporation. The assignment of the inventors to this corporation was recorded on June 9, 1998 at Reel/ Frame 9241/0526.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to Appellant, Appellant's legal representative or the assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending Appeal.

STATUS OF THE CLAIMS

Claims 1, 4, 5, 7, 11 and 13-15 stand final rejected. Claims 2-3, 6, 8-9, and 12 were previously canceled.

STATUS OF THE AMENDMENTS

There is no amendment after final to the claims.

A clean set of the claims on appeal is set forth in the Claim Appendix hereto.

SUMMARY OF THE INVENTION

The present invention includes an apparatus for reducing reflection on a surface of an optical lens assembly that has a wide angle of view. Such an apparatus includes a plurality of

concentric circular vanes, each of the vanes including a first end proximate the surface. The second end of the plurality of vanes is away from the surface. The first ends of the plurality of vanes are positioned closer together to each other than said second ends of said plurality of vanes. In more particular embodiments, the optical lens assembly includes optical lenses, wide FOV lenses, binoculars, telescopes, gun sights and night vision goggles. In further embodiments, the first ends of the plurality of vanes are positioned further apart from each other than the second ends of the plurality of vanes and the plurality of radial vanes are interconnected with the plurality of concentric circular vanes.

The following more particularly describes the present invention, where particular reference should be made to pages 4-7 of the subject application as well as to the figures referred to in the discussion that follows. In this regard, and for the convenience of the Board Members, a copy of Figs. 6-15 that are referred to below are provided in the Evidence Appendix, Tab A. Also, and for the Board Members convenience, a copy of each of the three references forming the basis for the grounds for rejection and provided in the Evidence Appendix, Tabs B-D.

There is shown in Fig. 6 a shield made up of deep tubes 32, the walls of which are not parallel, which shiled is placed in front of a wide-angle FOV optic 33. As shown in FIG. 7, such a shield would seem to have a structure 32 that would vignette the FOV 13 seen through a wide-angle FOV optic 33; as explained hereinafter this is not the case. See page 4, line 29 - page 5, line 3 of the subject application.

There is shown in Fig. 8, a common explanation found in physics text books of how a lens forms an image, in which a point 40 on the top of a lens 41 forms the image 42 of the top of

the subject 43, such as a candle, and the point 45 at the bottom of the lens forms the image 47 of the bottom of the subject 48. What actually happens is shown in FIG. 9, where each point on the lens, as shown with point 51, forms the image 54 of the entire subject 53. With this in mind, and with reference to Fig. 10, there is shown a further embodiment of the present invention, wherein the cell walls 60 that make up the tubes of the anti-reflection shield are arranged such that the walls are parallel to the varying view angles 61 contained within the optic's FOV. See page 5, lines 6-17 of the subject application.

As shown in Fig. 11, while in such an arrangement a tube wall 66 would block a point 62 at the top of the lens from seeing on a viewing angle 65 downwards to the bottom part of its normal FOV, there is a point 67 at the bottom of the lens that would have an unobstructed view on the view angle 65 through the tube formed by wall 68. Thus with this arrangement of tubes, the optical system will, *in total*, be able to maintain its full FOV in order to form a complete image, and the tubes in the shield can be made long enough to give effective glint protection.

In other words, the optical system of the present invention would be capable of maintaining its full field of view and thus allow the user of the optical system to see a complete image. As further explained in the subject application (see page 6, lines 22-27 thereof) that with this configuration, most points on the surface of the objective lens will have some of their lines of view blocked. This may cause a greater light loss than with the light loss from the earlier method of using a honeycomb of parallel-walled tubes. However, the increased light loss would be acceptable in many battlefield situations if this improved shield keeps the user of the optical device from being detected by the enemy because of reflections.

As also described in the subject application (see pages 5, line 28 – page 6, thereof) the tubes making up the anti-reflection shield can be arranged in various manners. For example, in a section through one embodiment of such a shield as shown in Fig. 12, the walls 60 could be arranged to form concentric tubes that have a conical section. These conical sections would be arranged so that their wall angles gradually splayed to accommodate the range of viewing angles contained or thin the wide-angle FOV 71 of the optical device to be protected 33. Alternatively, as shown in a section through another embodiment of such a shield in Fig. 13, the tube walls 60 could simply have one fixed angle and then be nested concentrically. The wall angles would be selected be related relation to the angle of the FOV of the optic that is to be protected 33. The center conical tube 77 would provide the clear sight lines to the center of the optic's FOV.

As shown in Fig. 14 in a section through yet another embodiment of such a shield, the walls that form the tubes 60 could splay inwards, rather than outwards. Further, with respect to the inwardly converging tubular elements as exemplified in Fig. 14, that tubular element configuration can provide the significant advantage of reducing reflections from a lens substrate that is significantly curved. That is, the inwardly converging tubular elements can effectively capture reflections from such a curved lens surface. Also, as shown in a front view in Fig. 15, to increase the glint masking ability of this new configuration of an anti-reflection shield, radial vanes 83 can be inserted between the concentric tubes 60 in a manner.

ISSUES

The issues on Appeal as to the rejections are:

1. Whether claims 1, 4, 5, 7, 11 and 14-15 are obvious within the meaning of 35 U.S.C. §103 as by Jones [USP 4,929,055] in view of Softly [USP 4,365,866].

2. Whether claim 13 is obvious within the meaning of 35 U.S.C. §103 as by Jones [USP 4,929,055] in view of Softly [USP 4,365,866] and further in view of Brennan [USP 4,323,298].

ARGUMENT

As to each issue Applicant has provide a separate argument applicable to the issue as indicated above. Unless otherwise indicated, any reference hereinafter in the Argument to specific reference numerals, pages or figures shall be to the pages and drawing figures of the subject application and the reference numerals used therein. Also, like reference characters/numerals denote corresponding parts.

FIRST ISSUE

CLAIMS 1, 4, 5, 7, 11 AND 14-15 ARE NOT OBVIOUS WITHIN THE MEANING OF 35 U.S.C. §103 AS BY JONES [USP 4,929,055] IN VIEW OF SOFTLY [USP 4,365,866]

The grounds for rejection asserts that Jones inherently discloses an apparatus for use with an optical device such as a binocular device, a telescope, a periscope, a riflescope, a night vision device or the like (see col. 1 thereof). Also, it is asserted that the apparatus disclosed by Jones teaches the use of a set of concentric circular vanes disposed in front of a lens surface of a lens assembly located within an optical device for the purpose of reducing the reflection of light incident on the lens reflecting surface of the lens assembly while still maintaining a substantially field of view for a user who makes an observation via the light passed through the vanes and the lens assembly. Each of the circular vanes has a first end disposed near the lens reflecting surface, and a second end disposed away from the first end. It is also noted that a combination of concentric circular vanes and radial vanes is disclosed by Jones (see fig. 9 thereof) .

Thus, the arrangement of a set of vanes disposed in front of a lens surface having a curved shape of an optical device for reduction light reflections incident on the lens surface so that the light reflected from such lens surface is essentially not viewable by an observer located distal from the second ends of the vanes and so that a user viewing through the lens assembly can observe the image corresponding to the wide field of view of the lens assembly. The Offir Action further asserts that the only feature missing from Jones is that Jones does not clearly teach that the first ends of the concentric circular vanes are spaced further apart from each other at a different distance than the second ends of the concentric circular vanes are spaced apart from each other as claimed in the present claims 1 and 15.

It is further asserted in the Office Action, that as to the arrangement of the vanes in front of an optical element, in another embodiment disclosed in column 5 of Jones and shown in figure 10 thereof, Jones has suggested that the vanes are arranged in a non-parallel manner and in inclined angles different from 90 degrees with respect to the lens reflecting surface of an optical device. It also is further asserted that while the embodiment provided at column 5, in Jones discloses the use of the inclined vanes in front of device having non-magnification feature such as a mirror or windshield; however, Jones allegedly teaches use of the inclined vanes in front of other optical devices having magnification.

It also is further asserted that the use of an array of vanes disposed in front of a lens surface having a curved shape for the purpose of reduction light reflections incident on the lens surface wherein the distance between two adjacent first ends near the lens surface of vanes is larger than the distance between two adjacent second ends farther from the lens surface of the

vanes for the purpose of reduction the light reflection incident on the lens surface is suggested to one skilled in the art from the system described in Softy. In particular, it is asserted that Softy discloses the use of an array of vanes (21) in front of a curved screen (11) and teaches that the vanes are arranged in a manner that the first ends near the curved screen is spaced further apart from each other at a different distance than the second ends disposed farther from the curved screen. See columns 2-3 and figs. 2-4, in particular, at column 2, lines 52-57 thereof which states: "In a television studio most of the ambient light falls towards the monitor screen from an upward direction rather from the side, and so the horizontally extending slats 21 are suitably positioned to intercept this light which would otherwise be reflected from the screen and impair the quality of the image."

Thus, it is asserted that it would have been obvious to one skilled in the art at the time the invention was made to modify the apparatus having vanes disposed in front of a lens reflecting surface of an optical device as provided by Jones (column 5, lines 10-34) by rearranging the orientation of the vanes so that the distance between two adjacent first ends of the vanes is different from the distance defined between two adjacent second ends of the vanes and the distance between two adjacent first ends near the lens surface of vanes is larger than the distance between two adjacent second ends farther from the lens surface of the vanes as suggested by Softy for the purpose of reducing the light reflection while still maintaining the wide field of view of the optical device.

Prior to addressing the grounds for the rejection in detail, Applicant first makes the following general observations regarding the rejection. Applicant would first note that the

phrases "wide-angle" or "wide-angle field of view" are not found in either Jones or Softly. While Jones makes reference to field of view, there is no specific reference to wide angle or wide angle field of view. This is not surprising as a text search of the issued patent for Jones that is available on the USPTO web site reveals that the phrase "wide angle" is not found in the issued patent. Also, such an assertion would be inconsistent with the express language in Jones. As to Softly, this reference clearly does not embody an optical device having an anti-reflection shield; thus, there can be no optical device having a wide angle field of view at all in Softly. In any event, a text search of the issued patent for Softly that is available on the USPTO website for Softly also reveals that the phrase "wide angle" is not found in the patent either. Also, such an assertion would be inconsistent with the express language in Softly.

Thus, as Jones and Softly do not use terminology relating to wide-angle field of view, it is improper to assert that these references inherently or expressly disclose use of anti-reflection devices with an optical lens assembly or an optical device having wide-angle field of view characteristics.

Secondly, Applicant would note that the example shown in Fig. 10 of Jones which forms a part of the grounds for the rejection and the entire disclosure in Softly which also forms a part of the grounds for the rejection are directed to use of a device(s) for minimizing or avoiding reflection from a surface of a non-optical device. In this regard, Jones specifically discloses that the term "non-optical" is being used in the sense that the device does not provide any optical magnification and that such a device might be a mirror or a glass surface such as the windshield 30 shown diagrammatically in Fig. 10 thereof. See Jones col. 5, lines 41-47.

Thus, the specific example from Jones and the Softly disclosure that is relied upon as support for the grounds do not relate at all to an optical lens assembly or an optical device much less one that is characterized as having a wide-angle field of view characteristic. Therefore, it is improper to assert that Jones and Softly inherently or expressly disclose use of anti-reflection devices with an optical lens assembly or an optical device having wide-angle field of view characteristics because the disclosures relied upon having nothing to do with optical devices as that term is used in Jones.

The following remarks are provided to address the grounds for rejection more particularly.

As indicated by Applicant during prosecution, claim 1 had been amended to clearly indicate that the user of the lens assembly is viewing the scene through the lens assembly and the anti-reflection apparatus. Also, claim 1 was amended to further provide that that the reflections from the surface of the lens assembly (*i.e.*, the surface of the lens) are not viewable by an observer that is distal or remote from the second ends of the anti-reflection apparatus. This was done so that the claimed structure was clearly different from the configurations disclosed in Fig. 10 of Jones and the disclosures of Softly which are non-optical types of devices.

Applicant has made the following observations in the subject application regarding the teachings and disclosures of Jones (see page 1, line 22 – page 3, line 7 thereof).

> An existing method of reducing or eliminating such reflections is to put a honeycomb grid of tubes in front of the objective lens (as is described in U.S. Patent #4,929,055, which is fully incorporated herein by reference). The tubes

in these devices have walls that are parallel to the optical axis of the device to which it is fitted.

This technique, however, is not an effective solution with wide-angle FOV devices, since if the length-to-width ratio of the tubes which make up the honeycomb of parallel-walled tubes is shallow enough not to vignette the view through the optic, then the tubes are not deep enough to give affective glint protection. This means that in a battlefield situation, wide-angle FOV optical devices are vulnerable to being detected by an enemy [sic.], and thus dangerous to use.

Accordingly, it is highly desirable, if not necessary, to devise other techniques for substantially preventing reflections from the reflecting surfaces of wide-angle FOV optical devices.

As can be seen in FIG.1, a reflective element 1 of an optical device 2 can reflect light rays 5 from a light source 3 to an observer 4. The Observer 4 includes sophisticated light detection systems possibly operating in the infrared and ultraviolet spectrums as well as human or animal observers.

An existing method of hiding such reflections is shown in FIG 2. where a honeycomb of parallel-walled tubes 6 is placed in front of the optical device 2. The walls of the tubes are parallel to the optical axis of the device to which it is fitted. This collection of tubes 6 prevents light from a source 3 from reflecting to an observer 4.

As shown in FIG. 3, the length-to-width ratio of the tubes 12 that make up the honeycomb cannot exceed the length-to-width ratio of the FOV 13 of the optical device to which it is fitted. In this way, the anti-reflection shield does not restrict field of view seen through the optical device.

As shown in FIG 4, an example of this would be the U.S. Army's PVS-7 night vision goggles, which have a FOV 13 of 40°. If one were to use the existing method of reflection protection, the length-to-width ratio of the deepest (longest) tubes 6 that could be used in a conventional anti-reflection shield are 1:1.38. This is not deep enough to give good glint protection. If deeper tubes are used, they would intrude on the FOV and vignette the image seen through the device, as illustrated in Fig. 5.

> The problem has been how to get tubes long enough to provide effective glint protection without vignetting the view through the optic.

Thus, the foregoing excerpt regarding the disclosures of Jones, at least in Applicant's view, that this the discussion regarding use of anti-reflection apparatus in combination with an optical device does not include the discussion starting in column 5, starting at line 38 thereof (*e.g.*, the discussion relating to "some applications" and the specific non-optical device example shown in Figs. 10-12 thereof). This is not surprising, as the patentee Jones and the applicant of the present invention are one in the same, and so it is not hard to see why applicant would know and understand more specifically what the patent teaches and discloses.

It appears that the principal basis for the Examiner's rejection is the language appearing in col. 5 line 35 through col. 6 line 16 which provides as follows:

> The tubular elements shown in the various above described embodiments of the invention are generally positioned so as to be substantially orthogonal to the reflective surface with which they are used. In some applications, it may be desirable to arrange them so that they are at other than a 90°angle with respect to the reflective surface in question. For example, FIG. 10 depicts an anti-reflective structure used with a non-optical device, the term non-optical being used here in the sense that the device does not provide any optical magnification. Such a device might be a mirror or a glass surface, such as a vehicle windshield 30 shown diagrammatically in FIG. 10 in a top view thereof. The vanes 31 which form the elements 32 are generally placed at various angles α other than 90°, with respect to the reflective surface of windshield 30 so as to follow the natural sight lines in the horizontal direction of an observer 33 looking through the windshield. FIG. 11 shows the vanes as positioned in the vertical direction wherein such vanes can be, if desired, arranged generally orthogonally to the windshield surface, the tubular elements

> of the overall structure being thereby positioned at various angles with respect to the reflective surface of windshield 30. The aspect ratios of each of the honeycomb-like elements 34, which are so formed, are selected to be substantially the same and can be selected as exemplified in FIG. 12. As seen therein, an exemplary aspect ratio (x/y) is depicted by the sides of rectangle 35 as shown. A desired aspect ratio can be selected to reduce reflections from sunlight, for example, which is expected to be directed at an angle with respect to the horizontal. For example, if the aspect ratio (x/y) of rectangle 35 is selected, reflections to an observer 36, for example, would be substantially reduced for sunlight angles greater than θ, but would not be so reduced for angles less than θ. Accordingly, the minimum angle from which sunlight is expected to be directed at the surface of the windshield 30 during use can be estimated, and the aspect ratio of elements 34 is appropriately selected as shown in FIG. 12 to reduce reflections of sunlight directed at such minimum angle, or greater.
>
> Structures in accordance with the invention can be relatively easily fabricated for use with the surfaces of many different types of optical devices or other reflective surfaces. Thus, in addition to use on binoculars, telescopes, periscopes, and the like, the structure can be used on vehicular windshields, head lamps, or side view mirrors, or the like.

As indicated above, the language referred in the above excerpt that is directed specifically to the example, is for a non-optical device which as indicated in Jones is a device that does not provided magnification. As such, it is completely improper to conclude that an anti-reflection device used for a windshield provides a basis to conclude that such a device would be reasonably successful if used with an optical device or a lens assembly that provides magnification.

As indicated in the subject application (see pg. 6, lines 22-27 thereof), for the configuration of vanes in the anti-reflection shield of the present invention most points on the

surface of the objective lens will have some of their lines blocked. Also, it is provided that this may cause greater light loss than with the light loss from the earlier method of using a honeycomb of parallel-wall tubes. As also provided in the subject application (see pg. 5, lines 1-3), the structure 32 of an anti-reflection shield according to an embodiment of the present invention is such that one could conclude that the structure would vignette the field of view 13 if seen through a wide-angle field of view optic 33. The subject application also provides that the common explanation found in physics text books of how a lens forms an image (see Fig. 8 thereof) is that a point 40 on the top of a lens 41 forms the image 42 of the top of the subject 43, such as a candle, and the point 45 at the bottom of the lens forms the image 47 of the bottom of the subject 48. In addition, the specific example also provides that the vanes are placed at various angles with respect to the windshield surface so as to follow the natual sight lines in the horizontal direction of an observer 33 looking through the windshield.

In sum and in view of the foregoing, there is no motivation or suggestion offered to one skilled in the art, to combine the teachings directed to the non-optical device example provided in Jones. One skilled in the art, would not have reasonable concluded, based on the teachings in Jones as well as the knowledge and understanding of those in the art, that the anti-reflection device described for the non-optical device application would not vignette the image being viewed by the optical device or optical magnifying lens assembly.

In contrast, the subject application explains why the basic explanation provided in physic text books is not what actually occurs. It also is the subject application, and not Jones, which provides that even though some lines of sight might be blocked by the tubes of the anti-reflection

shield of the subject application, the optical system will "in total" be able to maintain its fill field of view and thus be capable of forming a complete image. This, is nowhere described not disclosed in Jones.

The remarks on page 7 of the Final Office Action, also state that Softly discloses the use of a plurality of slats located in front of an optical lens having a curved lens surface which slats [sic.] are adjustable in their orientation for the purposes of reducing light reflection. Such a recitation apparently reflects an erroneous understanding of the disclosures and teachings in Softly.

As described in Softly, the slats 21 comprising the light masking device are configured and arranged so that the horizontally extending slats are disposed between a television monitor and a camera, where the slats are provided to address reflections off the television screen. As also described in Softly, the horizontally extending slats are viewed edge on by the camera 32 and so they do not interfer with the normal viewing by the camera 32 of the image being displayed on the screen of the monitor except to the extent of the slat's thickness which it is provided is minimal (*e.g.*, se col. 2, lines 57-61). It also is described in Softly that the horizontally slats are configured and arranged so as to be suitably positioned to intercept light that otherwise might be reflected from the screen and thus impair the image being displayed on the screen.

It is further provided that the slats 21 in Softly are constrained so as to converge on a horizontal line at a selected height and a selected distance from the screen of the monitor. Moreover, Softly further describes that the slats of the light masking device intercepts the light

from an upward direction because most of the light falls towards the monitor screen from the upward direction rather than the side.

In sum, Softly teaches that the slats, which are arranged to only extend horizontally and arranged so as to have a specific arrangement with respect to the camera, can prevent reflections from the surface of the television monitor. Thus, the slats in Softly are *not* provided so as to be in front of the lens of the camera 32 to prevent reflections off the camera kle4ns from being seen. This is particularly the case, because Softly specifically teaches that the slats 21 are differentially inclined with respect to the horizontal so as to converge on a horizontal line at a selected height and distance from the screen 11. It is further taught that the selection of height and distance depend upon the position chosen for the camera 32. Thus, in Softly the camera is remote from the slats and as taught in Softly the orientation of the slats is dictated so that they converge at a given height and distance from the screen whereat the camera 32 is presumably located.

Furthermore, it is not taught or suggested anywhere in Softly that a three dimensional array of such slats, such as in the form of concentric circles that extend lengthwise would have the same affect. Moreover, there is no teaching or suggestion that if an observer was on the television side of such a slat assembly that the observer could see through such a slat assembly. To the contrary, an arrangement of concentric vanes as taught by Applicant forms a structure where a vane could occlude a part of the scene being observed in contrast to a vane that is not at an angle with respect to normal from the lens surface. Thus, one skilled in the art would be more likely to conclude that such an arrangement of the slats would create an apparatus where the camera 32 would not be able to see the screen. In addition, it should be noted that the

arrangement of the camera, the slats and screen is not anywhere the same as that claimed by Applicant.

Finally, Softly teaches continuously modifying the angular orientation of the slats based on the location of the camera 32 with respect to the screen. Stated another way, Softly teaches adjusting the angular orientation of the slats as function of the height and distance of the camera from the screen. Therefore, what Softly teaches is continuously adjusting the angle of the slats so the camera/observer moves with respect to the television screen so that the camera/observer can see the television screen.

In sum, the teachings in Softly are not directed to the optical lens assembly of the camera but rather to the light masking device provided to shield the surface of a television monitor being observed by the camera so that light is not reflected off the television screen.

Therefore, Jones alone or in combination with Softly includes no teaching or suggestion of an apparatus for reducing reflection on a surface of an optical lens assembly that is configured so as to have a wide field of view (FOV), where the surface in question corresponds to an input end of the lens assembly in which is inputted light of the images being viewed. Further, there is no teaching or suggestion in Jones alone or in combination with Sofltly that such an anti-reflection includes a plurality of concentric circular vanes, mounted in front of said reflective surface of the optical lens assembly, each of said vanes including a first end proximate said surface, and a second end distal from said lens surface. Where said first ends of said plurality of vanes are spaced apart from each other at a different distance than said second ends of said plurality of vanes are spaced apart from each other, and where said first ends of said plurality of

vanes are spaced further apart from each other than said second ends of said plurality of vanes where light from an image to be viewed enters said second ends and exits said first ends and passes to said lens assembly input end. Also, Jones alone or in combination with Softly further teaches or suggests that said plurality of concentric circular vanes are arranged such that light reflecting from said lens surface is essentially not viewable by an observer located distal from said second ends and so that a user viewing through the lens assembly can observe the image corresponding to the wide field of view of the lens assembly.

It appears from a reading of the grounds for rejection and the remarks regarding Applicant's prior arguments, that Applicant's arguments are being ignored because of the decisions in, and holdings, of *In re Keller*, 208 USPQ 871 (CCPA 1981) and In re Merck & Co., 231 USPQ 375 (CAFC 1986). As discussed further below, the holding of *In re Keller* is being in appropriately applied in the present case and the holdings in the *In re Merck* decision makes this clear.

The Court in *In re Keller* noted that the sole issue regarding the prior art rejection is essentially whether the references taken collectively, would have suggested the use of digital timing in a cardiac pacer to those of ordinary skill in the art at the time the invention was made.[1] As the Court further noted

> To justify combining reference teachings in support of a rejection it is not necessary that a device shown in one reference can be physically inserted into the device shown in the other. (Citations omitted). The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary

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[1] 208 USPQ 871, 880.

> reference; nor is that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. (Citations omitted).

As to the references being cited in the grounds for the rejection, the Court in *In re Keller* provided the following.

> Both Keller and Berkovits disclose heart stimulators that use R-C type timing circuits. Walsh teaches the use of digital type timing circuits in place of R-C type timing circuits in conventional heart stimulators. Therefore, the question is whether it would have been obvious to one of ordinary skill in the art, working with the Keller and Berkovits and the Walsh references before him, to do what the inventors herein have done, that is, to use a digital timing circuit in a cardiac pacer. (Citations omitted). We agree that the references establish a prima facie case of obviousness. [2]

In reaching a similar conclusion, the Court in *In re Merck* noted that the expectation that compounds having similar structures would behave similarly was suggested in a Report. It also noted that the combination with those teachings, the prior art teaching that the precise structural difference between amitriptyline and imipramine involves a known bioisosteric replacement provides sufficient basis *for the required expectation of success, without resort to hindsight* (emphasis added). Although the Court indicated that obviousness does not require absolute predictability, a reasonable expectation that the beneficial result will be achieved is necessary to show obviousness. (Citations omitted).[3]

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[2] 208 USPQ 871, 881-882.
[3] 231 USPQ 375, 379.

In sum, it is clear from these two decisions that to avoid hindsight reconstruction one must show that the prior art clearly discloses a reasonable expectation of success or that there is a reasonable expectation that the beneficial result will be achieved.[4] Applicant respectfully submits that one could not conclude that, based on the disclosures of the Jones and Softly references, one skilled in the art would have been reasonably apprised that re-configured the concentric vanes taught in Jones for the optical device application with vanes that are at angle with respect to a normal to the surface of an optical lens assembly having a wide-angle field of view, would have allowed one to look through such an optical lens assembly and thence through the plurality of vanes and still be capable of observing a complete image (*i.e.*, not a vignetted image) while at the same time preventing light coming in from any angle from being reflected from the surface. Thus, and contrary to the assertion in the Office Action, *In re Keller* cannot be used as the basis for asserting there is motivation to combine Jones and Softly.

As also indicated above, in Softly, the slats 21 are disposed between the screen of a television monitor and a camera so that the camera can view the television screen and so that the horizontally extending slats are viewed edge on by the camera 32 (*i.e.*, so they do not interfer with the normal viewing by the camera 32 of the image being displayed on the screen of the monitor). In sum, Softly teaches providing slats to address reflections from a non-optical device the television screen and not the camera and re-orienting the slats as the position of the camera

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[4] As provided in MPEP 2143.02, a prior art reference can be combined or modified to reject claims as obvious as long as there is a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 19866).

with respect to the screen changes. This is completely different from that being claimed by Applicant.

There also is no indication anywhere in Jones or for that matter Softly, of the problem identified in the subject application (problem has been how to get tubes long enough to provide effective glint protection without vignetting the view through the optic). There also is no suggestion anywhere in Jones or Softly that the solution to this problem is having the vanes arranged such that light reflecting from the lens surface of the wide-angle field of view lens assembly is essentially not viewable by an observer located distal from the second ends and so that a user looking through the lens assembly can observe the image corresponding to the wide-angle field of view capability of the lens assembly.

As noted above and in the subject application, the problem with the device and methodology disclosed in Jones was that a part of the image that would be ordinarily seen when using an optical device or lens assembly having a wide-angle field of view, is being blocked by the outwardly extending tubular members described in the optical device embodiment in Jones thereby vignetting the view through the optical device or lens assembly.

What the Examiner has failed to show is that the disclosures in Jones or Softly, alone or in combination reasonably apprises one skilled in the art of the problem and the particular solution to the problem as is taught in the subject application. There also is no showing why or how one skilled in the art would upon reading the disclosure in Jones or Softly , alone or in combination, would have been taught and also would have understood that a wide-angle field of view image would not be completely blocked by the outwardly extending circular vanes if the

angle thereof was adjusted as taught by Applicant while at the same time maintaining the capability of not reflecting light to an unwanted observer.

It was Applicant in developing the present invention who realized that the user looking through the optical device or lens assembly would perceive the entire image observable with a wide angle optical device or lens assembly even though a portion of the reflection reducing apparatus (*e.g.*, a portion of a vane) may occlude a portion of the image. Such occlusion while it may appear as a decrease in intensity will not cause a loss of the complete image. Thus, the vane adjusting language allegedly in Jones and identified in the Office Action does not teach one skilled in the art that there would be blockage of part of the image be viewed by a wide-angle field of view optical device or lens assembly if the reflection reducing structure described in Jones was modified so as to embody the characteristics claimed and taught in the subject application. In fact, one skilled in the art would have continued to believe that the occlusion of the image in any degree would mean that the image could not be fully perceived.

The Examiner also disagrees with the assertion that the reconstruction of the references is a hindsight reconstruction. Applicant would that basis asserted as to why one skilled in the art would have combined the art in the suggested fashion was "for the purpose of reducing the light reflection while still maintaining the wide field of view of the optical device." As indicated herein, the phrase wide-angle or wide-angle field of view does not appear in either Jones or Softly. Thus, it appears an improper to assert that the motivation for combining the references includes a phrase that is not found at all in Jones or Softly. In sum, the only place where one finds such a teaching is the subject application.

In the grounds for the rejection, it appears that the Examiner admits that the specific example in Figs. 10-12 is not for an optical device, but then attempts to use the sentence directly preceding the discussion as some how decoupling the non-optical device teaching provided in Jones from applying to the specific example directed to Figs. 10-12 in Jones. Applicant respectfully submits that the sentence is being read out of context with the rest of the paragraph.

The portion of the paragraph being referred to reads as follows:

> The tubular elements shown in the various above described embodiments of the invention are generally positioned so as to be substantially orthogonal to the reflective surface with which they are used. In some applications, it may be desirable to arrange them so that they are at other than a 90°angle with respect to the reflective surface in question. For example, FIG. 10 ...

It appears form the Examiner's remarks, that the phrase "some applications" in the second sentence is being interpreted as being inclusive of optical devices even though this is not so stated. As to the suggestion, that this is inclusive of only optical devices, such a meaning is inconsistent with the language of the following sentence that provided "For example, Fig. 10" which is admitted as being an non-optical device. Thus, a more consistent reading of the second sentence is that the some applications was directed to non-optical device applications particularly in light of the following discussion directed to FIG. 10 of Jones.

Moreover, it should be recognized that whatever the language this sentence in col. 5 is intended to mean, it is completely silent and lacks any detail, beyond the specific example, as to what applications are considered as being within the "some applications." The Federal Circuit

has indicated that a prior art reference that gives only general guidance and is not all that specific as to particular forms of a claimed invention and how to achieve it, may make a certain approach obvious to try, but does not make the invention obvious. *Ex Parte Obukowicz*, 27 USPQ2d 1063, citing *In re O'Farrell*, 853 F.2d 894, 7 USPQ2d 1673,1681 (Fed. Cir. 1988). Also, such a disclosure hardy corresponds to a teaching or suggestion that the modification suggested in the grounds for the rejection would be reasonably successful.

In conclusion, Applicants respectfully submits that:

(1) There is no express teaching or desire provided in either Jones or Softly to combine either reference. In re Keller does not provide a basis to make such a combination either.

(2) The express assertion in the Office Action that Softly teaches an optical device in which slats are provided in front of the lens of an optical device is erroneous. The only optical device in Softly is the camera and the camera is disposed a distance from the slats.

(3) The express assertion in the grounds for rejection of the claims in the Office Action that the embodiment shown in Figs. 10-12 in Jones is an optical device, is inconsistent with other admissions in the Office Action and also if so asserted would be clearly erroneous.

(4) Jones and Softly do not provide any suggestion, teaching or disclosure that the modification suggested by the combination would be reasonably successful.

(5) Jones and Softly do not anywhere described the vignetting problem described in the subject application for optical devices or lens assemblies having a wide-angle field of view, in particular with regards to the disclosures in Jones. There also is no description of the solution to the problem described in Jones or Softly.

(6) The teachings in Softly for variable orientation of slats is directed to the changing of the angular orientation of the slats dependent upon the location of the camera with respect to the television screen. Thus, in Softly the angular orientation is taught as being changed as the camera moves with respect to the television screen.

(7) In Softly the external light sources of concern are in fixed relation to the television screen, whereas the present invention is concerned with light coming from different and changing locations with respect to the lens assembly.

As provided in the MPEP, obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *In re Fine*, 837 F. 2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F. 2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). As provided above, the references cited, alone or in combination, include no such teaching, suggestion or motivation.

Furthermore, and as provided in MPEP 2143.02, a prior art reference can be combined or modified to reject claims as obvious as long as there is a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 19866). Additionally, it also has been held that if the proposed modification or combination would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. Further, and as provided in MPEP-2143, the teaching or suggestion to make the claimed combination and the reasonable suggestion of

success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). As can be seen from the forgoing discussion regarding the disclosures of the cited references, there is no reasonable expectation of success provided in any of the references as to the claimed invention and the specific motivation asserted in the Office Action for making the combination is only found in applicant's disclosure.

The Federal Circuit also has indicated that a prior art reference that gives only general guidance and is not all that specific as to particular forms of a claimed invention and how to achieve it, may make a certain approach obvious to try, but does not make the invention obvious. *Ex Parte Obukowicz*, 27 USPQ2d 1063, citing *In re O'Farrell*, 853 F.2d 894, 7 USPQ2d 1673,1681 (Fed. Cir. 1988).

Also, the Federal circuit has stated, "[t]he mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 972 F.2d 1260,1266, 23 USPQ2d 1780, 1783-84 (Fed. Cir. 1992). Obviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor. *Para-Ordance Mfg. v. SGS Importers Int'l, Inc.*, 73 F.2d 1085, 1087, 37 USPQ2d 1237, 1239 (Fed. Cir. 1995).

As the Federal Circuit has stated in *In re SANG-SU LEE*, 271 F.3d 1338, 1342-1344; 277 USPQ 2d 1430 (Fed. Cir. 2002):

> The factual inquiry whether to combine references must be thorough and searching." *Id.* It must be based on objective evidence of record. This precedent has been reinforced in myriad decisions, and cannot be dispensed with. *See, e.g., Brown & Williamson Tobacco Corp. v. Philip Morris Inc.*, 229

> F.3d 1120, 1124-25, 56 USPQ2d 1456, 1459 (Fed.Cir.2000) ("a showing of a suggestion, teaching, or motivation to combine the prior art references is an 'essential component of an obviousness holding' ") (quoting *C.R. Bard, Inc., v. M3 Systems, Inc.*, 157 F.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed.Cir.1998)); *In re Dembiczak*, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed.Cir.1999) ("Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references."); *In re Dance*, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed.Cir.1998) (there must be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant); *In re Fine*, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1600 (Fed.Cir.1988) (" 'teachings of references can be combined *only* if there is some suggestion or incentive to do so.' ") (emphasis in original) (quoting *ACS Hosp. Sys., Inc. v. Montefiore Hosp.*, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed.Cir.1984)).
>
> The need for specificity pervades this authority. *See, e.g., In re Kotzab*, 217 F.3d 1365, 1371, 55 USPQ2d 1313, 1317 (Fed.Cir.2000) ("particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed"); *In re Rouffet*, 149 F.3d 1350, 1359, 47 USPQ2d 1453, 1459 (Fed.Cir.1998) ("even when the level of skill in the art is high, the Board must identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination. In other words, the Board must explain the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious."); *In re Fritch*, 972 F.2d 1260, 1265, 23 USPQ2d 1780, 1783 (Fed.Cir.1992) (the

> examiner can satisfy the burden of showing obviousness of the combination "only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references").

As indicated herein the motivation for the combination provided in the Office Action is not language found in either Jones or Softly but rather is the language and teachings found in Applicant's invention.

As provided by the Federal circuit, a 35 U.S.C. §103 rejection based upon a modification of a reference that destroys the intent, purpose or function of the invention disclosed in a reference, is not proper and the prima facie case of obviousness cannot be properly made. In short there would be no technological motivation for engaging in the modification or change. To the contrary, there would be a disincentive. *In re Gordon*, 733 F. 2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Jones and Softly alone or in combination do not teach nor suggest the anti-reflection apparatus of claim 1; in particular the cited art does not provide any teaching or suggestion of an anti-reflection device that can be used with a optical device or lens assembly having a wide-angle field of view and still retain the capability of the lens assembly to provide a complete image and not an image cut-off by the anti-reflection apparatus; and more specifically an anti-reflection apparatus embodying the vane structure in claim 1 that allows the anti-reflection apparatus to be used with a wide-angle field of view lens assembly/optical device and at the same time make any reflections from the optical device/ lens assembly essentially un-viewable to an observer who is distal or remote from the apparatus.

It thus is respectfully submitted that for the foregoing reasons there is no teaching, nor is there any motivation or desires offered in Jones or Softly (alone or in combination) that would suggest to one skilled in the art to take the an anti-reflection shield in Jones and shown in with Figs. 3-9 and to modify the structure of such an anti-reflection shield so as to yield the anti-reflection apparatus as claimed by Applicant which anti-reflection apparatus is particular suited for use with a wide-angle field of view optical device/lens assembly. Thus for the foregoing reasons claims 1, 4, 5, 7, 11, 14 and 15 are patentable over Jones in view of Softly.

SECOND ISSUE

CLAIM 13 IS NOT OBVIOUS WITHIN THE MEANING OF 35 U.S.C. §103 AS BY JONES [USP 4,929,055] IN VIEW OF SOFTLY [USP 4,365,866] AND FURTEHR IN VIEW OF BRENNAN [USP 4,323,298]

As indicated above claim 13, depends from claim 1 and thus at least for this reason, the obviousness rejection of claim 13 is deemed addressed above, in the discussion concerning claims 1, 4, 5, 7, 11, 14 and 15. Thus, and at least for this reason claim 13 is considered patentable over the combination of Jones and Softly.

The grounds for rejection of claim 13 provides that Brennan is cited for the further teaching of what specific angle(s) for a lens so it is considered as having a wide-angle field of view.

It thus is submitted that Brennan does not overcome the shortcomings identified above regarding the rejection of claims 1, 4, 5, 7, 11, 14 and 15.

As such it is respectfully submitted that claim 13 is considered patentable over the combination of Jones, Softly and Brennan.

Respectfully submitted,
Edwards Angell Palmer & Dodge, LLP

Date: May 4, 2006

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APPENDIX

CLAIM APPENDIX

1. (Previously Presented) An apparatus for reducing reflection on a surface of an optical lens assembly that is configured so as to have a wide field of view (FOV), said surface corresponding to an input end of the lens assembly in which is inputted light of images being viewed, said apparatus comprising:

a plurality of concentric circular vanes, mounted in front of said reflective surface, each of said vanes including a first end proximate said surface, and a second end distal from said lens surface, wherein said first ends of said plurality of vanes are spaced apart from each other at a different distance than said second ends of said plurality of vanes are spaced apart from each other, and wherein said first ends of said plurality of vanes are spaced further apart from each other than said second ends of said plurality of vanes where light from an image to be viewed enters said second ends and exits said first ends and passes to said lens assembly input end; and

wherein said plurality of concentric circular vanes are arranged such that light reflecting from said lens surface is essentially not viewable by an observer located distal from said second ends and so that a user viewing through the lens assembly can observe the image corresponding to the wide field of view of the lens assembly.

4. (Previously Presented) The apparatus of claim 1 wherein said lens assembly is contained within field goggles and wherein said apparatus is configured to be mounted on field goggles.

5. (Original) The apparatus of claim 4 wherein said field goggles include night-vision goggles.

7. (Original) The apparatus of claim 1 further including:
a plurality of radial vanes interconnected with said plurality of concentric circular vanes.

11. (Previously Presented) The apparatus of claim 1, wherein said first ends of said plurality of vanes are spaced apart from each other at a fixed distance and said second ends of said plurality of vanes are spaced apart from each other at a fixed distance.

CLAIM APPENDIX

12. (Previously Presented) An apparatus for reducing reflection on a surface comprising:

a plurality of concentric circular vanes, mounted in front of said reflective surface, each of said vanes including a first end proximate said surface, and a second end away from said surface;

the plurality of concentric circular vanes comprising a center vane and a plurality of outer vanes;

the center circular vane forming a conical tube with the first end having a smaller diameter than the second end; and

the outer vanes being nested concentrically about the center vane such that the plurality of concentric circular vanes have one fixed angle.

13. (Previously Presented) The system of claim 1, wherein the wide angle Field of View (FOV) of an optical lens of said lens assembly is at least 40°.

14. (Previously Presented) The system of claim 1, wherein the plurality of concentric circular vanes are arranged so as to produce tubes with a length-to width ratio greater than the length to width ratio of the FOV.

15. (Previously Presented) An apparatus for reducing reflection from a surface of a wide angle Field of View (FOV) optical lens assembly, said apparatus comprising:

a plurality of concentric circular vanes, mounted in front of said reflective surface, each of said vanes including a first end proximate said surface, and a second end away from said surface, wherein said first ends of said plurality of vanes are spaced apart from each other at a different distance than said second ends of said plurality of vanes are spaced apart from each other, wherein said plurality of concentric circular vanes are arranged such that light reflecting from said lens surface is essentially not viewable by an observer located distal from said second ends and so that a user viewing through the wide FOV lens assembly can view an image

CLAIM APPENDIX

corresponding to the wide field of view of the lens assembly, whereby a wide field of view through the reflective surface is maintained.

EVIDENCE APPENDIX

Tab A	Copy of Figs. 6-15 of the subject application
Tab B	Copy of USP 4,929,055
Tab C	Copy of USP 4,365,866
Tab D	Copy of USP 4,323,298

RELATED PROCEEDINGS APPENDIX

None

A

FIG. 6

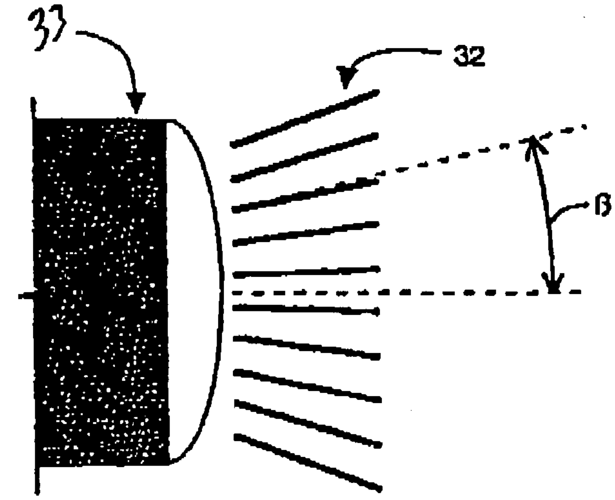


FIG. 7

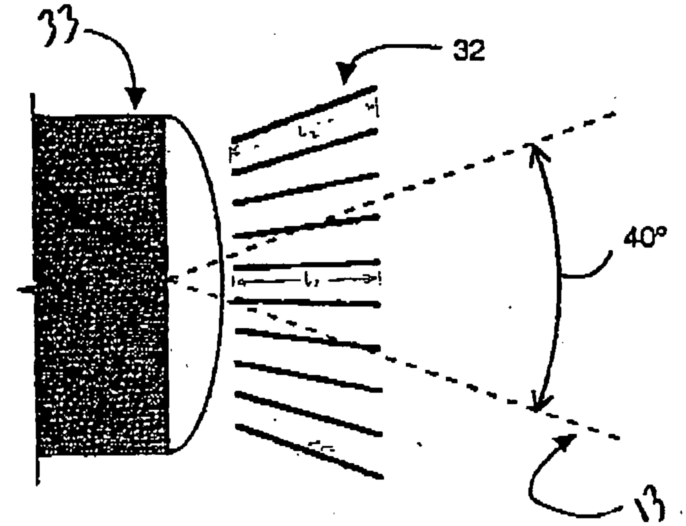


FIG. 8

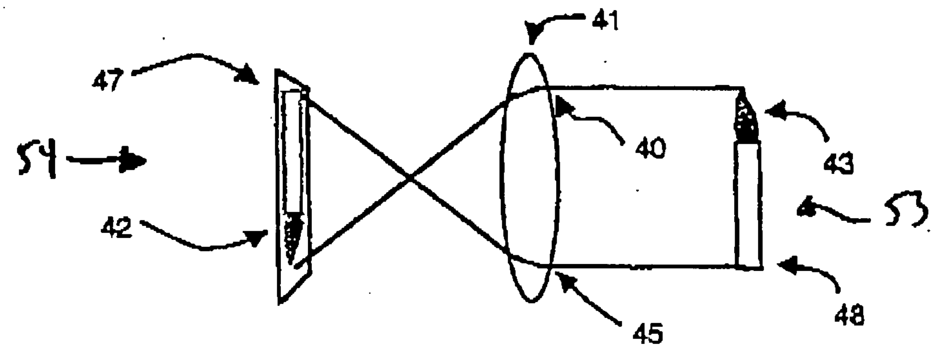


FIG. 9

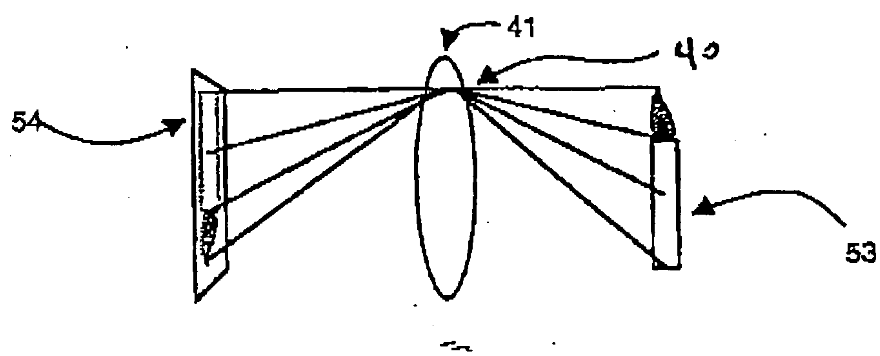


FIG. 10

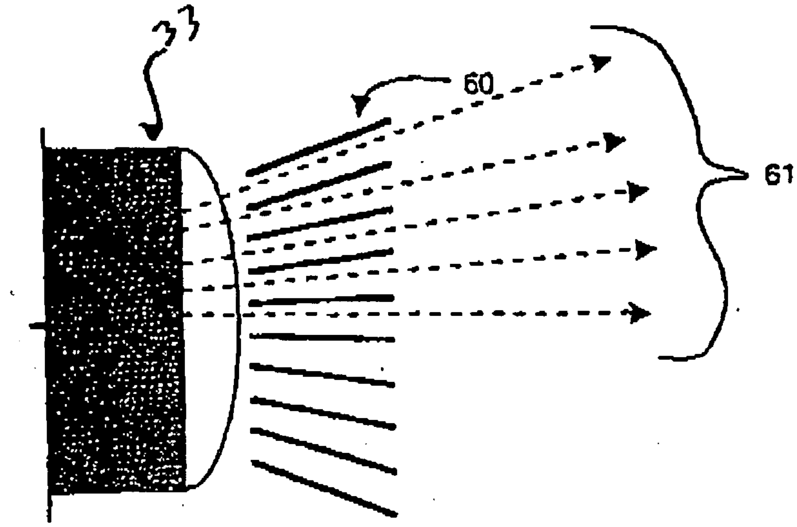


FIG. 11

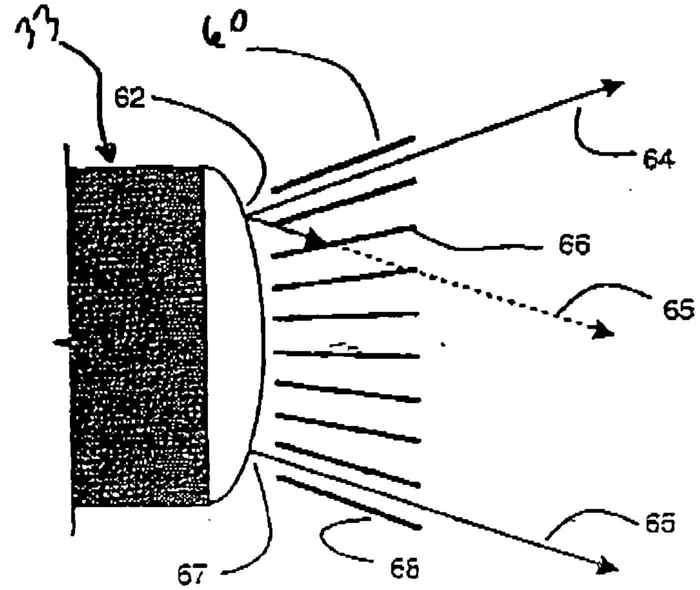


FIG. 12

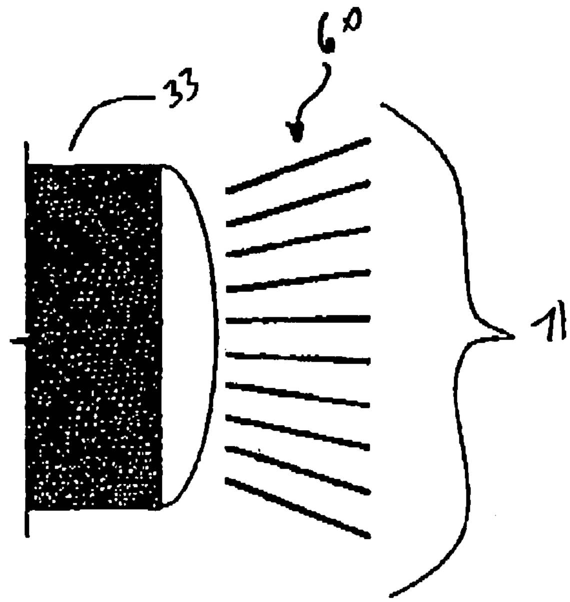


FIG. 13

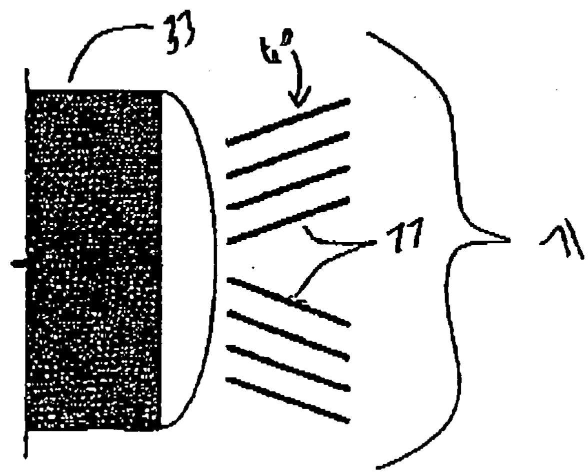


FIG 14

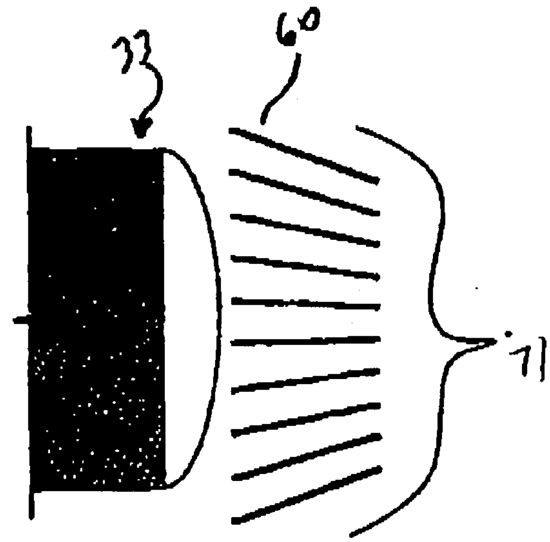
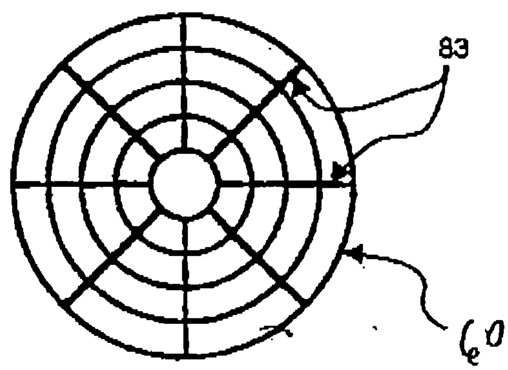


FIG 15



B

United States Patent [19]

Jones

[11] Patent Number: 4,929,055

[45] Date of Patent: May 29, 1990

[54] ANTI-REFLECTION TECHNIQUE

[76] Inventor: Peter W. J. Jones, 70 Oakley Rd., Belmont, Mass. 02178

[21] Appl. No.: 246,436

[22] Filed: Sep. 19, 1988

[51] Int. Cl.[5] G02B 27/00

[52] U.S. Cl. .... 350/276 R; 350/319

[58] Field of Search .... 350/276 R, 276 SL, 284, 350/322, 319

[56] References Cited

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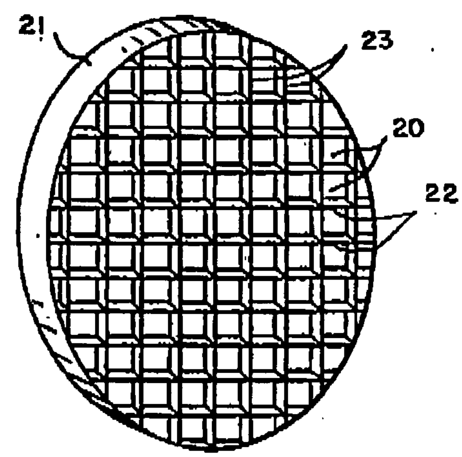
Primary Examiner—Bruce Y. Arnold
Assistant Examiner—Loha Ben
Attorney, Agent, or Firm—Robert F. O'Connell

[57] ABSTRACT

A structure for use in reducing reflections as from a light reflecting surface of an optical device. The structure utilizes a plurality of substantially tubular elements mounted in front of the reflective surface. In a preferred embodiment, the aspect ratio of the tubular elements being selected to be substantially the same as that of the optical device.

22 Claims, 3 Drawing Sheets



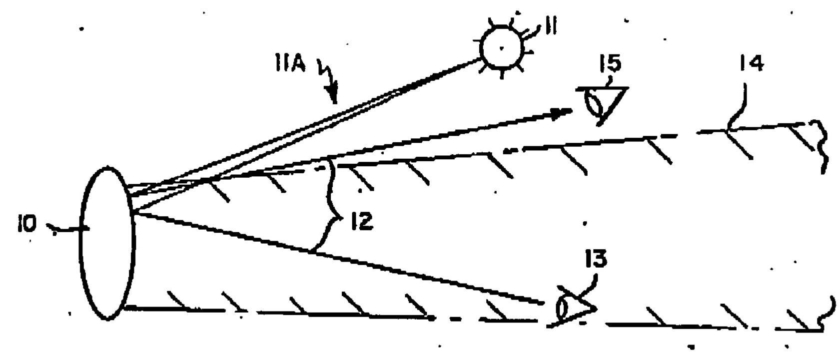


FIG. 1

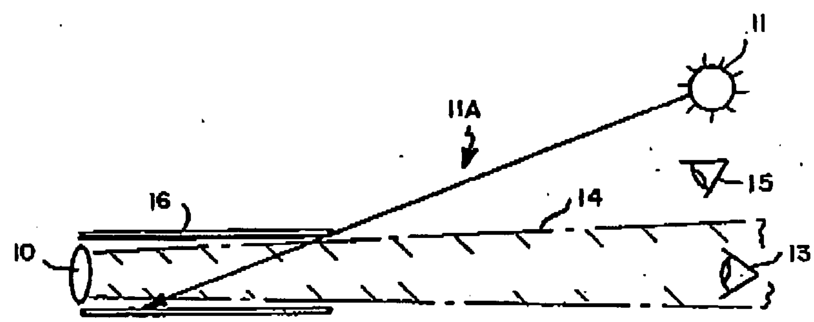


FIG. 2 PRIOR ART

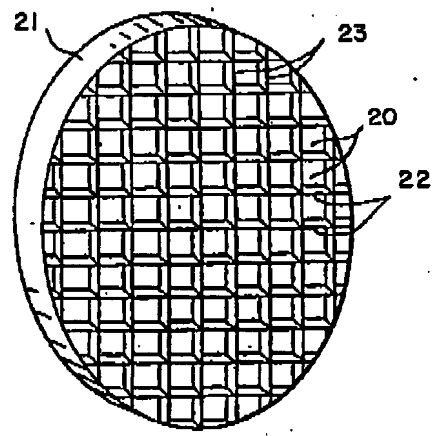


FIG.3

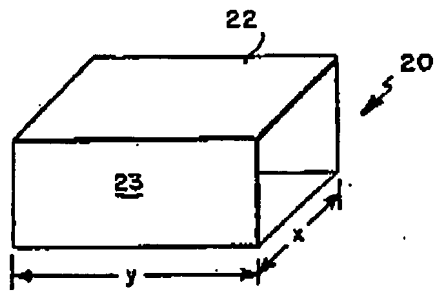


FIG.4

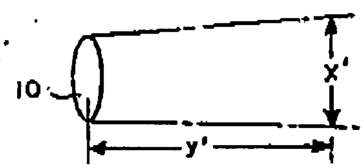


FIG.5

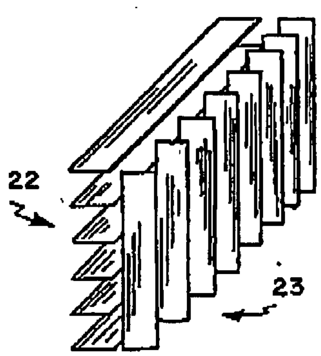


FIG.6

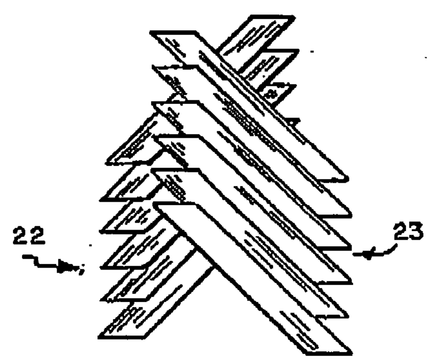


FIG.7

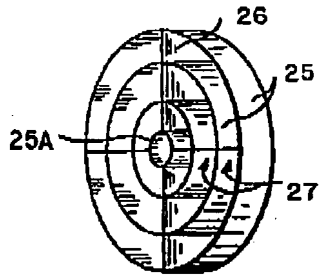


FIG.8

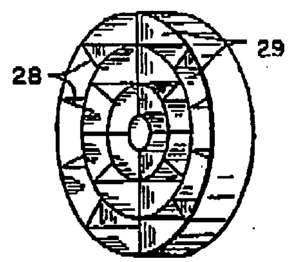


FIG.9

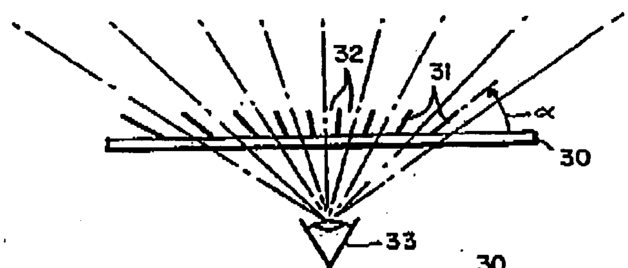


FIG.10

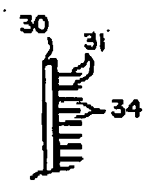


FIG.11

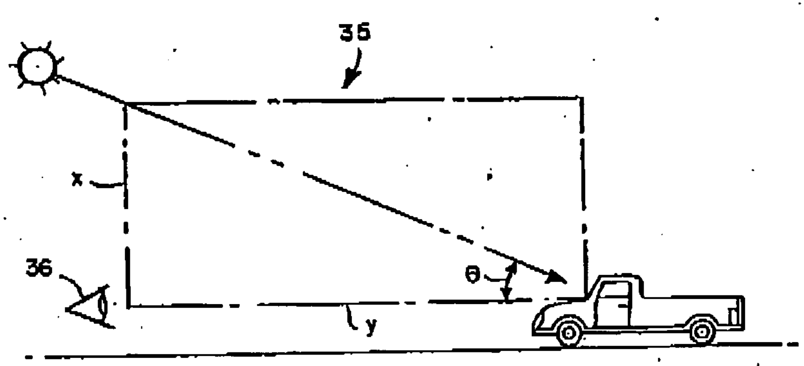


FIG.12

ANTI-REFLECTION TECHNIQUE

INTRODUCTION

This invention relates generally to techniques for the minimization of light reflections from reflective surfaces and, more particularly, to the prevention of light reflections from the reflective surfaces of optical or other devices.

BACKGROUND OF THE INVENTION

When using optical devices, for example, for ranging, guidance, communication or information gathering, such as binoculars, telescopes, periscopes, rifle scopes and the like, in daylight hours and particularly in sunlight, reflections of the sunlight can be readily observed. The observation of such reflections can be especially troublesome and even dangerous, for example, during warfare when such devices are being used in a battleground situation. Reflective flashes of light, for example, can alert enemy observers as to the location of personnel and/or equipment and permit fire, or other retaliating measures, to be directed at such locations.

Reflections may also be a problem at night, from moonlight or artificial light sources, as when night vision devices are being used by observers. Such reflections can also occur from other optically reflective surfaces, such as mirrors and headlamps on vehicles, and the like, to the detriment of field troops in the vicinity thereof. Such reflection problems have become even more serious lately for battlefield troops with the introduction of scanning laser beams used in locating and/or ranging devices, which beams can produce relatively high intensity and readily indentifiable reflections from glass or other mirror or mirror-like surfaces.

At present, the only practical solutions available have been to avoid using the optical devices in question, at least when the sun or other light source is in front of the reflective surface, or to cover up the reflective surfaces in some manner, or remove the optical devices or other reflective surfaces entirely, or to use an optical shade, or hood, adapted to fit on a device in much the same manner as a camera lens hood or shade is fitted to a camera lens.

An obvious disadvantage of the use of some of the above solutions is to eliminate or seriously reduce the information gathering capabilities of the field forces which depend upon such information to improve their effectiveness. Further, personnel may not remember, or be able, to remove, cover up, or otherwise neutralize or minimize the reflectiveness of the surfaces involved.

Moreover, many optical devices, such as binoculars, telescopes, and the like, have a relatively narrow field of view. Accordingly, the use of a standard-type lens shade having an aspect ratio that adequately corresponds to such narrow field of view so as to prevent undesired reflections is impractical since it results in a relatively long and extremely cumbersome lens shade. For example, for 10×50 binoculars, a suitable lens shade would be over two feet long, with even longer shades required for higher power devices. Such an approach becomes entirely impractical for most, if not all, situations.

Accordingly, it is highly desirable, if not necessary, to devise other techniques for substantially preventing reflections from the reflecting surfaces of optical or

other devices due to the incidence thereon of sunlight, laser beams, or other light sources.

SUMMARY OF THE INVENTION

In accordance with the invention, a structure comprising a plurality of tubular elements is positioned in front of a light reflecting surface of an optical device, each of the tubular elements having a selected cross-sectional configuration. The tubular elements form a grid-like, or honeycomb-like, or other similar, structure. The aspect ratio of each of the elements has a selected relationship with respect to the aspect ratio of the field of view of the optical device on which the structure is positioned. Accordingly, reflections from light sources generally in front of the device are substantially reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be described in more detail with the help of the accompanying drawings wherein:

FIG. 1 depicts diagrammatically the geometry of a typical situation in which reflections from an optical device can occur;

FIG. 2 diagrammatically illustrates the use of an optical lens hood for reducing reflections from an optical device;

FIG. 3 depicts a particular embodiment of a structure in accordance with the invention for us in reducing reflections from an optical device;

FIGS. 4 and 5 are useful in explaining the concept of aspect ratio as used in connection with the embodiment of FIG. 3;

FIG. 6 depicts an alternative embodiment of the vanes of FIG. 3;

FIG. 7 depicts a still further alternative embodiment of the vanes of FIG. 3;

FIGS. 8 and 9 depict still further alternative embodiments of the invention using circular rings;

FIG. 10 depicts a top diagrammatic view of a use of the invention for an exemplary windshield structure;

FIG. 11 depicts a side diagrammatic view of the structure of FIG. 10; and

FIG. 12 depicts diagrammatically the geometric relationship of the aspect ratio of the embodiment shown in FIGS. 10 and 11 to the elevation angle of the sun.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As can be seen in FIG. 1, a typical front lens 10 of an optical device (the remainder of which is not shown) acts as a highly reflective surface for reflecting rays of light from a light source 11 in front of the lens, which source may be, for example, the sun or an artificial light source, such as a laser beam source. The incident light, e.g. as shown by exemplary rays 11, is reflected from the surface of lens 10, as depicted by exemplary rays 12, to a viewer 13 who is within, or a viewer 15 who is outside, the field of view of the device, which is shown, for example, by dashed line 14. Thus, such observers can readily detect the location of the optical device by observing the reflections that are so produced.

FIG. 2 shows a proposed technique of the prior art for preventing such reflections by the use of a conventional lens hood 16 positioned in front of the lens 10. Observers 13 and 15, both inside and outside the field of view 14, will not see reflections from a light source 11 positioned outside the field of view as shown. Moreover, observers outside the field of view will not see

reflection from a light source with the field of view. However, in order to obtain such operation, the lens hood 16 has to be made relatively long (perhaps as long as, or longer than, two feet for a typical 10×50 lens as mentioned above) in order to be sufficiently effective in preventing observers from seeing such reflections. Such an inordinately long lens hood would be entirely too awkward and cumbersome for most applications and is particularly impractical for field use applications.

FIG. 3 shows one preferred embodiment of a structure in accordance with the invention for substantially preventing reflections from a reflecting surface, as from the surface of a lens 10 of an optical device. As seen therein, a grid-like, or honeycomb-like, structure comprising a plurality of tubular elements 20 are fabricated within a mounting structure, such as a ring 21, having a configuration which permits the structure to be attached, in a suitable manner which would be well known to the art, at the front reflective surface of such a lens. When so attached, the tubular elements are substantially orthogonal to the reflective surface of the lens, as shown.

As used herein the term tubular element is deemed to mean an element of a generally tubular configuration having any selected geometrical cross-sectional shape. Thus, the tubular elements 20 in FIG. 3 are shown as being square in cross-section, although other shapes can be used, e.g., other rectangular configurations, a triangular configuration, an hexagonal configuration, etc., such elements capable of being suitably nested to form a substantially uniform honeycomb or grid-like overall structure. In FIG. 3, the walls of the tubular elements are, in effect, formed from a plurality of orthogonally intersecting horizontal and vertical vanes 22 and 23, respectively.

Preferably, in order to provide the most effective reduction in reflections from a reflective surface of an optical device, as from lens 10, the aspect ratio of each of the tubular elements has a selected relationship to the aspect ratio of the field of view of such optical device. As used herein, the aspect ratio of a tubular element is defined as the ratio of the width, or effective, diameter of the opening thereof to the length thereof. As shown in FIG. 4 for the square configuration such aspect ratio is defined as the ratio of x to y, where "x" is one side of the square and "y" is the length of element 20. The aspect ratio of the field of view of the optical device, e.g. lens 10, can be best understood from the diagrammatic view of FIG. 5 wherein such ratio is defined as the ratio of the width "x'" of the field of view at a some specified distance "y'" from the lens. If the aspect ratio of the tubular element is made substantially equal to the aspect ratio of the field of view of the optical device with which it is used (i.e., $x/y=x'/y'$), a substantial reduction of reflections therefrom is obtained without reducing the field of view of the optical device. That is, reflections from a light source anywhere outside the field of view of the device will not be seen by an observer who is either within or outside such field of view and reflections from a light source within the field of view of the device will not be seen by an observer who is outside the field of view.

Thus, in a typical embodiment for a lens such as a lens used in 10×50 binoculars, in which the aspect ratio of the field of view thereof is 10:1, the width of the openings of each of the tubular elements can be about 0.25 in. and the length of the tubular elements can be about 2.50 in. in order to produce a substantial reduction in reflections. A structure, such as shown in FIG. 3, is relatively simple to fabricate and would be easy to use under any conditions.

In some applications, a lesser reduction in reflections can be tolerated while still providing useful results. Thus, in some cases the aspect ratio of the tubular elements need not be substantially the same as the aspect ratio of the field of view of the optical device with which they are used. Even when the aspect ratios are somewhat different, the structure can still provide a useful reduction of reflections for some applications. While such differences in the aspect ratios tend to increase the region over which reflections can be observed, in such cases there will be less loss in light intensity and such a trade-off may be desirable in some cases.

It is found that the use of such a structure, even when providing substantial reductions in reflections, does not normally impair the ability of the optical device to be used for its desired viewing purpose. For example, if the lens 10 represents the front lens of a binocular or ocular device, the user of the device suffers substantially little or no impairment in the sharpness of the image seen therethrough. While some loss in light intensity tends to occur, it can be readily accommodated by the eyes of the user (for example, while the light intensity can be reduced by as high as 50% at when achieving substantial reflection reduction, such reduction will not really adversely affect the use of the device). Moreover, because the anti-reflection structure is relatively shorter than the focal length of the optical device, the grid-like, or honeycomb-like, structure is sufficiently out of focus that it is effectively not seen by the user of the device.

While the cross-sectional configuration of the tubular elements 20 is shown as a square, as mentioned above, the cross-section can be of other desired configurations, e.g., other rectangular shapes, triangular, hexagonal, or the like, without effecting the desired operation thereof. Generally, it is desirable that the shape selected permit the elements to be nested in a tight honeycomb-like structure so that the aspect ratios of all of the tubular elements are substantially the same.

While the structure of FIG. 3 can be made so that during use the elements 20 rest at, or substantially near to, the surface of lens 10, it is also possible to position such structure so as to provide a sufficient gap between the lens surface and the structure so that water, as from rain, or from the sea in the case of a submersible periscope device, for example, will readily drain from the device.

Alternatively, the vanes 22 can be placed in a different, but adjacent, plane from the plane of the vanes 23 in a manner such as shown in FIG. 6, where, during normal use, vanes 22 are substantially horizontally oriented and vanes 23 are substantially vertically oriented. Water will be blocked from entering the openings between vanes 22 and will readily drain through vanes 23. In a still further alternative embodiment as shown in FIG. 7 both sets of orthogonally related vanes can be arranged at 45° angles from a horizontal orientation so that, during normal use, water can be readily drained through both sets thereof. To further assist such drainage, the vanes can be coated with a suitable hydrophillic material.

Moreover, the vanes can be arranged to be heated in any suitable manner to remove snow or ice therefrom. For example, the use of electrically conductive material, either for the vanes themselves or as a material attached to the vanes, can permit them to be heated

from an electrical power source to melt ice or snow therefrom during use.

In some optical devices, the device may use a reflective laser filter mounted within the housing of an optical device which filter structure is highly reflective particularly in selected regions of the visible spectrum. In such devices, it may be desirable to position a honeycomb-like structure of the invention directly in front of such filter within the device housing rather than at the exterior of the housing at the front lens thereof.

Further alternative structures may be used in some applications, if desired. For example, the anti-reflection structure may be in the form of concentric rings, or cylindrical elements, such as shown in FIG. 8 wherein a plurality of rings 25 are attached to each other by suitable struts 26 at opposite points thereon. The spacing 27 between the rings is substantially the same. The aspect ratio of the centermost ring 25A is selected to be substantially the same as that of the field of view of the optical device on which it is used, the remaining rings being spaced so that the width of the slot formed by each ring and its adjacent ring approximately maintains the desired aspect ratio. Such a structure can also provide adequate anti-reflection capability in many applications.

The structure of FIG. 8 can be modified to provide a structure as shown in FIG. 9 wherein a plurality of interconnecting struts 28 effectively form honeycomb-like, or grid-like, elements 29. In such a structure, the cross-sectional areas of elements 29 are arranged to be approximately equal so that their aspect ratios are also approximately the same and approximately equal to the aspect ratio of the field of view of the optical device with which they are used.

The tubular elements shown in the various above described embodiments of the invention are generally positioned so as to be substantially orthogonal to the reflective surface with which they are used. In some applications, it may be desirable to arrange them so that they are at other than a 90° angle with respect to the reflective surface in question. For example, FIG. 10 depicts an anti-reflective structure used with a non-optical device, the term non-optical being used here in the sense that the device does not provide any optical magnification. Such a device might be a mirror or a glass surface, such as a vehicle windshield 30 shown diagrammatically in FIG. 10 in a top view thereof. The vanes 31 which form the elements 32 are generally placed at various angles α, other than 90°, with respect to the reflective surface of windshield 30 so as to follow the natural sight lines in the horizontal direction of an observer 33 looking through the windshield. FIG. 11 shows the vanes as positioned in the vertical direction wherein such vanes can be, if desired, arranged generally orthogonally to the windshield surface, the tubular elements of the overall structure being thereby positioned at various angles with respect to the reflective surface of windshield 30. The aspect ratios of each of the honeycomb-like elements 34, which are so formed, are selected to be substantially the same and can be selected as exemplified in FIG. 12. As seen therein, an exemplary aspect ratio (x/y) is depicted by the sides of rectangle 35 as shown. A desired aspect ratio can be selected to reduce reflections from sunlight, for example, which is expected to be directed at an angle with respect to the horizontal. For example, if the aspect ratio (x/y) of rectangle 35 is selected, reflections to an observer 36, for example, would be substantially reduced for sunlight angles greater than θ, but would not be so reduced for angles less than θ. Accordingly, the minimum angle from which sunlight is expected to be directed at the surface of the windshield 30 during use can be estimated, and the aspect ratio of elements 34 is appropriately selected as shown in FIG. 12 to reduce reflections of sunlight directed at such minimum angle, or greater.

Structures in accordance with the invention can be relatively easily fabricated for use with the surfaces of many different types of optical devices or other reflective surfaces. Thus, in addition to use on binoculars, telescopes, periscopes, and the like, the structure can be used on vehicular windshields, head lamps, or side view mirrors, or the like.

Other modifications of the invention will occur to those in the art within the spirit and scope of the invention. Hence, the invention is not to be construed as limited to the particular embodiments discussed and shown in the figures, except as defined by the appended claims.

What is claimed is:

1. A structure for reducing reflections from a light reflective surface of an optical device having a field of view with an aspect ratio, said structure comprising:
   - a plurality of substantially tubular elements, each having an aspect ratio, mounted in front of said reflective surface, the aspect ratio of each of said tubular elements having a selected relationship with respect to the aspect ratio of the field of view of said optical device to substantially reduce said reflections.

2. A structure in accordance with claim 1, wherein the aspect ratio of each of said tubular elements is substantially the same as the aspect ratio of the field of view of said optical device.

3. A structure in accordance with claim 1, wherein said tubular elements are mounted substantially orthogonally to said reflective surface.

4. A structure in accordance with claim 3, wherein all of said tubular elements have substantially the same cross-sectional configuration.

5. A structure in accordance with claim 4, wherein said cross-sectional configuration is rectangular.

6. A structure in accordance with claim 4, wherein said cross-sectional configuration is a square.

7. A structure in accordance with claim 4, wherein said cross-sectional configuration is hexagonal.

8. A structure in accordance with claim 4, wherein said cross-sectional configuration is triangular.

9. A structure in accordance with claim 3 wherein said structure is formed from a first plurality of parallel vane and a second plurality of parallel vanes arranged orthogonally to said first plurality of vanes.

10. A structure in accordance with claim 9, wherein, during use of the optical device, said first plurality of vanes are horizontally oriented said second plurality of vanes are substantially vertically oriented.

11. A structure in accordance with claim 9, wherein, during use of the optical device, said first and second vanes are at substantially a 45° angle with respect to a horizontal orientation.

12. A structure in accordance with claim 9 wherein the surfaces of said first and second vanes are coated with hydrophillic material.

13. A structure in accordance with claim 1, wherein the aspect ratio of each of said tubular elements is differ-

ent from the aspect ratio of the field of view of said optical device.

14. A structure in accordance with claim 1, wherein said plurality of tubular elements form a honeycomb-like structure.

15. A structure in accordance with claim 1, wherein said structure is mounted so as to provide a gap between said structure and said reflective surface.

16. A structure for reducing reflections from a light reflective surface of an optical device having a field of view with an aspect ratio comprising

a plurality of tubular elements, each having an aspect ratio, mounted in front of, and orthogonally to, said reflective surface, the aspect ratio of each of said tubular elements having a selected relationship with respect to the aspect ratio of the field of view of said optical device to prevent reflections of light rays from a light source outside the field of view of said optical device from being observed by an observer within or outside said field of view and to prevent reflections of light rays from a light source within said field of view from being observed by an observer outside said field of view.

17. A structure in accordance with claim 16, wherein said tubular elements comprise a plurality of concentrically mounted cylindrical elements.

18. A structure in accordance with claim 17, and further including a plurality of vanes interconnecting said concentric cylindrical elements to form a plurality of substantially tubular elements each having substantially the same cross-sectional area, the aspect ratios of said tubular elements being substantially the same.

19. A structure in accordance with claim 18, wherein said structure is mounted in front of the reflective surface of an optical device, the aspect ratios of said tubular elements having a selected relationship with respect to the aspect ratio of the field of view of said optical device.

20. A structure in accordance with claim 19, wherein the aspect ratios of said tubular elements are selected to reduce reflections from light sources which direct light on to said reflective surface at angles equal to or greater than a selected angle.

21. A structure in accordance with claim 1 or 16, wherein said tubular elements are positioned at various angles with respect to said reflective surface.

22. A structure in accordance with claim 21, wherein said reflective surface is a glass reflective surface said various angles being selected to correspond to the sight lines of an observer looking through said glass reflective surface.

* * * * *

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350-276 SR

12/28/82 OR 4,365,866

United States Patent [19]

[11] 4,365,866

[45] Dec. 28, 1982

Softly

[54] LIGHT MASKING DEVICE

[75] Inventor: Peter Softly, Toronto, Canada

[73] Assignee: Invisible Optics Inc., Toronto, Canada

[21] Appl. No.: 214,710

[22] Filed: Dec. 10, 1980

[51] Int. Cl.³ G02B 27/00

[52] U.S. Cl. .... 350/276 R

[58] Field of Search .... 350/58, 59, 60, 263, 350/268, 269, 270, 276 R, 276 SL, 284; 362/279, 290, 292, 325, 354

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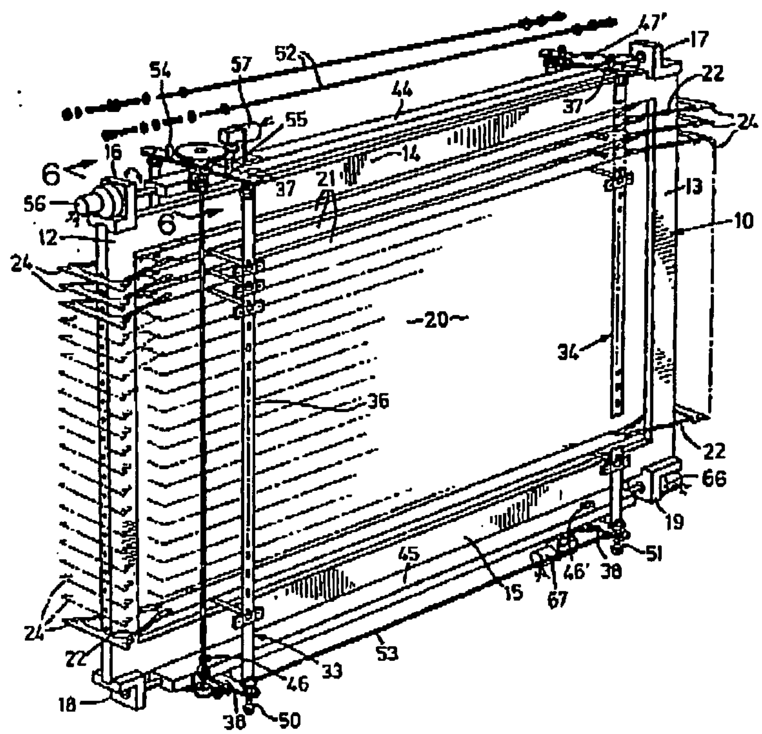
Primary Examiner—John K. Corbin
Assistant Examiner—Matthew W. Koren
Attorney, Agent, or Firm—Ridout & Maybee

[57] ABSTRACT

A light masking device in accordance with the present invention comprises a support frame adapted to be positioned in front of the screen and an optical filter supported thereby, the optical filter comprising a grating of spaced, elongated planar slats extending horizontally across the width of the screen, the slats being differentially inclined from the horizontal in the directions of their widths so as to converge on a horizontal line at a selected height and a selected distance from the screen. In a preferred embodiment of the invention the slats are pivotally connected to the support frame for pivotal movement about respective horizontal axes, and means are provided for differentially adjusting the inclinations of the slats for selectively adjusting the position of the horizontal line on which the inclined slats converge.

11 Claims, 8 Drawing Figures



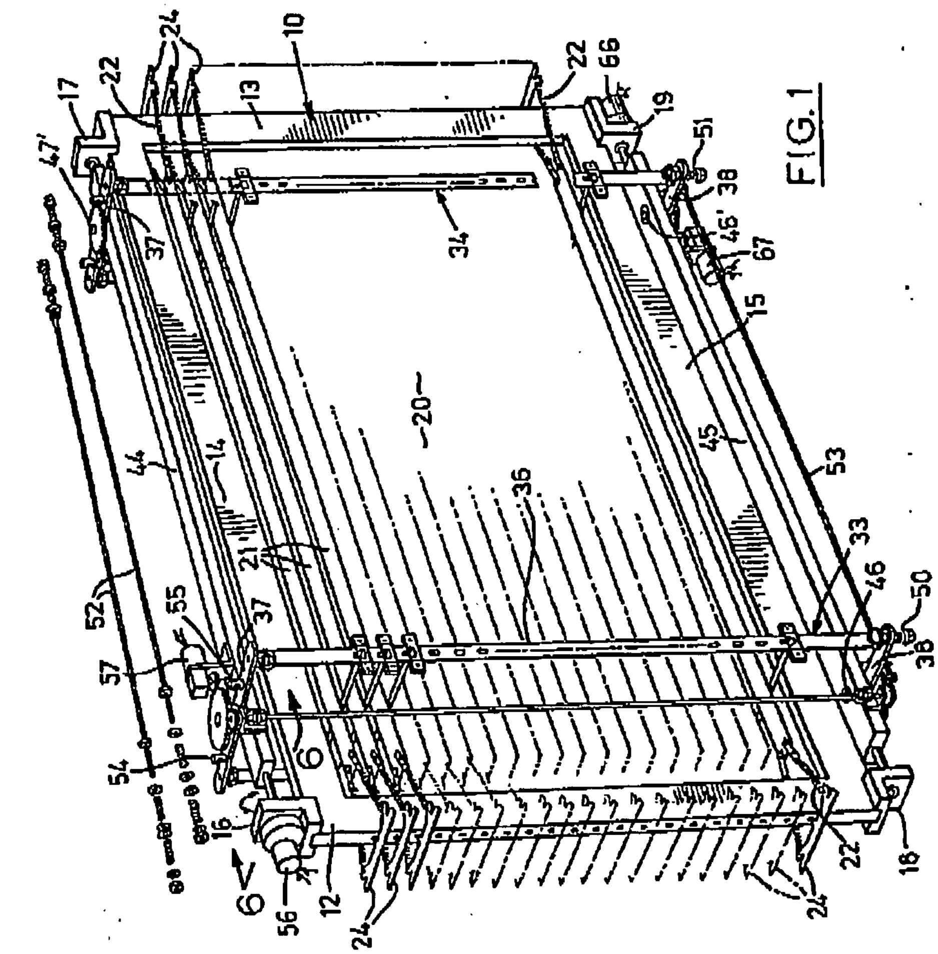

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FIG. 1

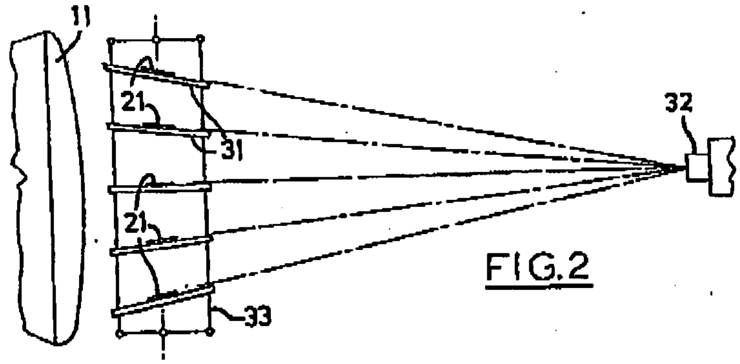

FIG. 2

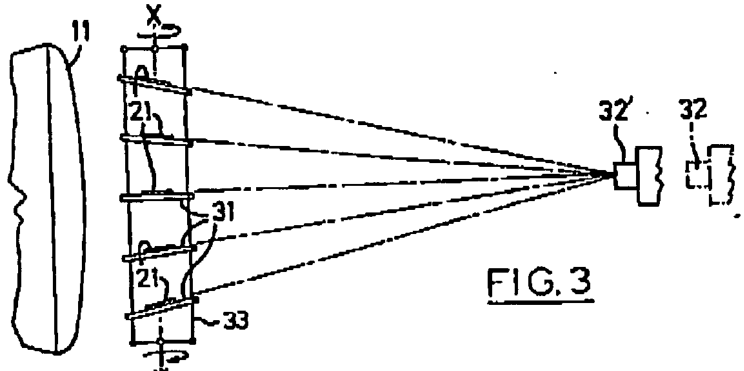

FIG. 3

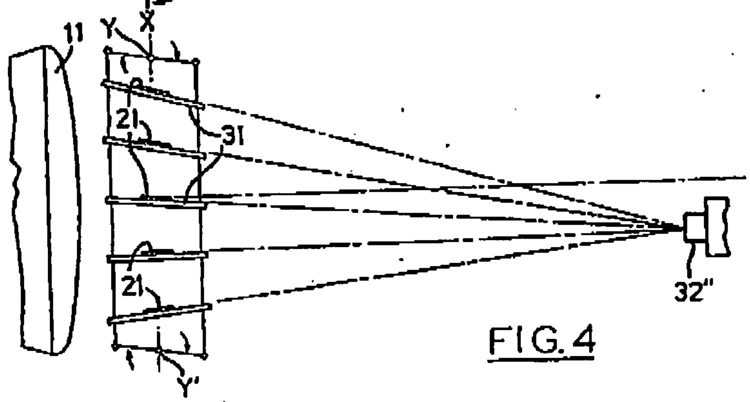

FIG. 4

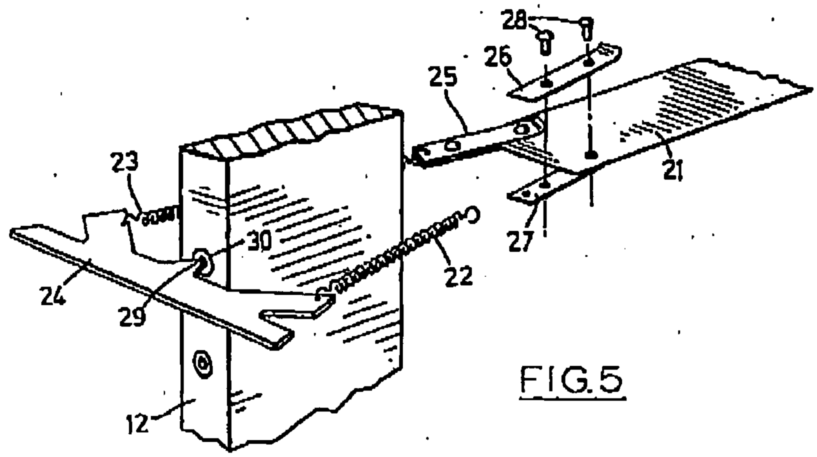
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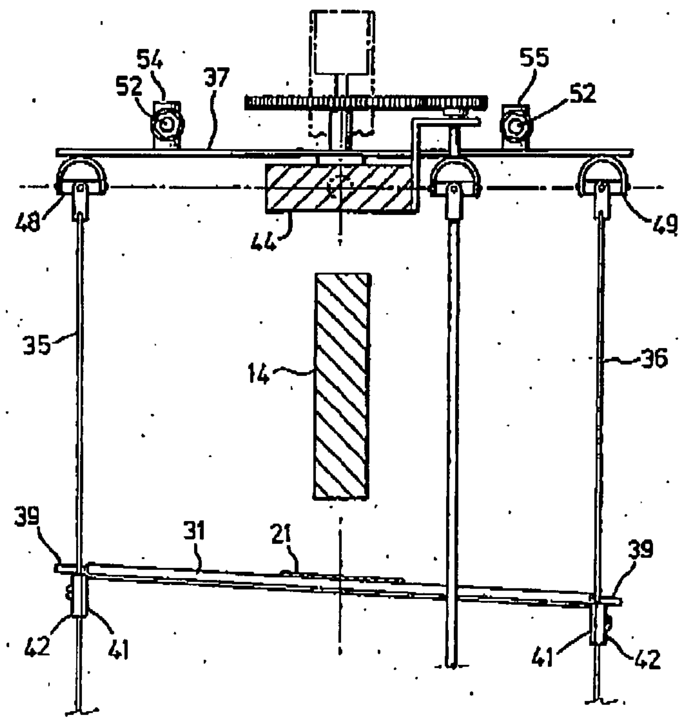
FIG.5

FIG.6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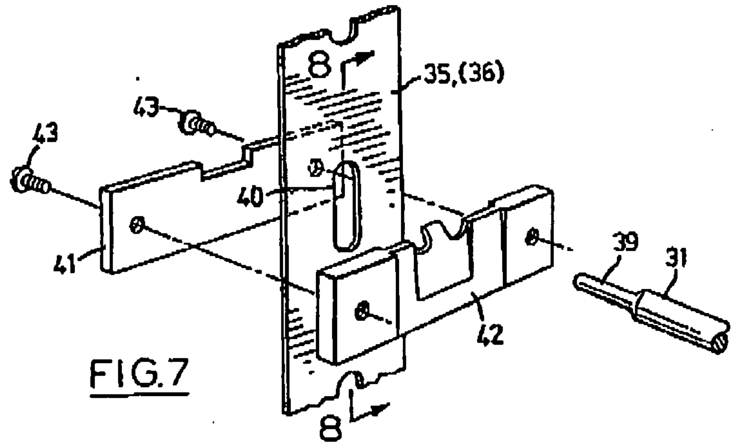

FIG.7

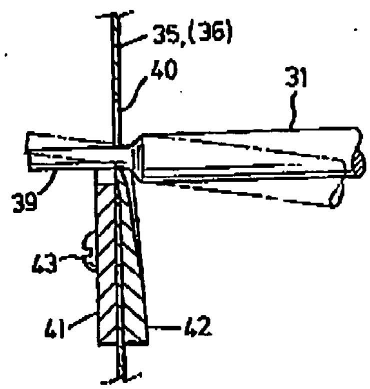

FIG.8

LIGHT MASKING DEVICE

This invention relates to a light masking device for improving image contrast on a television or similar video display screen under conditions of high ambient light. The device is of the type having an array of light intercepting surfaces which extend across the field of view for intercepting ambient light and which are oriented so as not to interfere with viewing from the normal viewing direction.

Devices of this general type have previously been proposed, examples of such devices being described in U.S. Pat. Nos. 2,388,203, 3,582,189 and 4,165,920. A somewhat similar device, adapted for use as a light shield for a camera, is described in U.S. Pat. No. 2,373,936. These prior devices have but limited application. Since their light intercepting elements are oriented so as to lie in parallel planes extending in a predetermined viewing direction, they preclude interference-free viewing from any position which is offset from the predetermined viewing direction or any position at which the effect of parallax is significant. Such devices are quite unsuitable for use with a video display screen such as, for example, a studio monitor screen, which has to be viewed from a selected camera position.

It is one object of the present invention to provide a light masking device for use with a studio monitor screen wherein the light intercepting elements are oriented so as to permit substantially interference-free viewing from a selected viewing position.

Another object of the invention is to provide such a light masking device in which the orientations of the light intercepting elements can be adjusted to suit changes of the viewing position.

A light masking device in accordance with the present invention comprises a support frame adapted to be positioned in front of the screen and an optical filter supported thereby, the optical filter comprising a grating of spaced, elongated planar slats extending horizontally across the width of the screen, the slats being differentially inclined from the horizontal in the directions of their widths so as to converge on a horizontal line at a selected height and a selected distance from the screen.

In a preferred embodiment of the invention the slats are pivotally connected to the support frame for pivotal movement about respective horizontal axes, and means are provided for differentially adjusting the inclinations of the slats for selectively adjusting the position of the horizontal line on which the inclined slats converge.

In order that the invention may be readily understood, one preferred embodiment thereof will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a general perspective view of the device, part of the adjustment mechanism being shown in exploded view for clarity of illustration;

FIGS. 2, 3 and 4 are simplified diagrams illustrating the principle of adjustment of the device to suit different viewing positions;

FIG. 5 illustrates a pivotal mounting of one of the light intercepting elements or slats;

FIG. 6 is a view on line 6—6 in FIG. 1;

FIG. 7 is an exploded view of a clamp forming part of the adjustment mechanism; and

FIG. 8 is a section on line 8—8 in FIG. 7.

The light masking device illustrated in the drawings comprises a rectangular rigid support frame 10 which is adapted to be positioned in front of the screen of a television studio monitor 11 (FIGS. 2, 3 and 4). The support frame consists of a pair of upright end members 12, 13 and a pair of upper and lower cross members 14, 15. The support frame defines a rectangular viewing opening which obviously must be large enough to permit uninterrupted viewing of the monitor screen 11 when it is operatively positioned. Also mounted at the ends of the cross members 14, 15 are pairs of brackets 16, 17 and 18, 19 which provide pairs of aligned pivots for the purpose hereinafter described.

Supported by the support frame 10 is an optical filter 20 comprising a grating of spaced, elongated planar slats 21 which extend horizontally across the width of the support frame within the rectangular viewing opening. These slats are preferably of stainless steel, typically 0.002 inches in thickness, and their opposite sides are treated to provide matt, substantially non-reflecting light intercepting surfaces. Each slat 21 is supported under tension in the direction of its length, by means illustrated in detail in FIG. 5. As shown in FIG. 5, the end of the slat 21 is connected via a pair of tension springs 22, 23 to a pivot bar 24. The connections between the slat and the tension springs are effected by means of connectors 25 each consisting of a pair of thin flexible metallic strips 26, 27 between which the end of the slat is sandwiched, the strips 26, 27 being secured together by rivets 28.

The pivot bar 24 has a pointed bearing projection 29 which engages in a locating recess 30 of the frame member, thus defining a pivotal connection to the frame member. The other end of the slat 21 is similarly connected to the opposite frame member 13, the two pivotal connections being horizontally aligned with one another; the slat is thus pivotally connected to the support frame and thereby mounted for pivotal movement about a horizontal axis.

All the slats 21 of the grating are similarly mounted for pivotal movement about respective horizontal axes, as illustrated in FIG. 1. The horizontal pivotal axes of the slats are preferably equally spaced apart. However, as illustrated in FIG. 2, the slats 21 do not lie in parallel planes but are constrained by bearing links 31 to lie in planes which are differentially inclined with respect to the horizontal so as to converge on a horizontal line at a selected height and a selected distance from the screen 11. The selection of height and distance depend upon the position chosen for the television camera 32, of course, which in FIG. 2 is horizontally aligned with the centre of the screen 11. In a television studio most of the ambient light falls towards the monitor screen from an upward direction rather than from the side, and so the horizontally extending slats 21 are suitably positioned to intercept this light which would otherwise be reflected from the screen and impair the quality of the image. At the same time all the slats 21 are viewed edge on by the camera 32, and so do not interfere with normal viewing of the image except to the extent of their thickness which is minimal.

It will be appreciated that the diagrammatic drawings do not necessarily show the recommended spacings of the slats, which must be chosen according to studio working requirements.

In a light masking device according to the present invention the slats 21 may be set at predetermined inclinations, corresponding for example to the grating con-

figuration shown in FIG. 2. In this case the device may only be used with a television camera positioned as shown in FIG. 2. However, in the present example the slats can be differentially adjusted to suit a range of camera positions. For this purpose the bearing links 31 which constrain the slats form parts of a parallel linkage mechanism 33. In fact, as shown in FIG. 1 and as hereinafter described, there are two interconnected parallel linkage mechanisms 33, 34, but for the purpose of describing their function it will be sufficient to refer to one. The mechanism 33 can be rotated about a vertical axis X—X, as illustrated in FIG. 3, so as to vary the angles at which the bearing links 31 traverse the slats, and so to vary differentially the inclinations of the slats with respect to the horizontal. Thus, if a shorter focal distance is required, as when the camera 32 is moved to a position 32' (FIG. 3), the parallel linkage mechanism must be rotated about the axis X—X, causing each bearing link to exert a cam action on its associated slat thereby increasing the angle of inclination of the slat. Since the slats are planar and have parallel edges, they must always lie in planes converging on a horizontal line despite such adjustment.

The end links of the parallel linkage mechanism 33 are mounted for pivotal movement about respective horizontal axes Y, Y' (FIG. 4). By pivotally moving the end links about these axes, the inclinations of the slats are again differentially adjusted, in this case to vary the height of the line on which they converge so as to suit a new camera position, e.g. the position 32" of FIG. 4.

Each parallel linkage mechanism 33, 34 comprises a pair of upright links 35, 36 and a pair of end links 37, 38 extending transversely to the slats 21. The bearing links 31 extend between the upright links to which they are pivotally connected at their ends in the manner shown in FIGS. 7 and 8. Each link 31 has a reduced end portion 39, at each end, which projects through a vertically elongated slot 40 in the upright link 35 or 36. The reduced end portion 39 bears on an accurately positioned bearing edge formed by a pair of adjustable clamping members 41, 42 clamped together by screws 43. Thus the orientations of the bearing links can be accurately preset. Each of the slats 21 bears on a respective one bearing link of each of the parallel linkage mechanisms 33, 34 and is constrained thereby to lie in a plane determined by the inclination of the pair of bearing links with respect to the horizontal. As previously mentioned, the end links 37, 38 are mounted for pivotal movement about respective horizontal axes Y, Y' (FIG. 4). The end links are so mounted on elongated bars 44, 45 which are themselves pivotally connected between the pairs of brackets 16, 17 and 18, 19. The end links of each pair are also pivotally connected to the bars 44, 45 by vertically aligned, pivotal connections 46, 47 and 46', 47'. By this means the parallel linkage mechanisms can be articulated with respect to their horizontal and vertical pivotal axes as described with reference to FIGS. 3 and 4.

It is necessary that the upright links 33, 34 be universally pivoted to the end links 37, 38. Such universal pivots are shown at 48 and 49 in FIG. 6. As shown in FIG. 1, the lower ends of the upright links resiliently engage the end links by adjustable springs 50, 51. It is also necessary that the parallel linkage mechanisms be exactly complementary to one another so that the slats will remain planar and not become skew. For this purpose the corresponding end links 37, 38 of the two mechanisms are interconnected by pairs of tie rods 52, 53 which are connected at their ends to the end links by swivels 54, 55. The complementary relationship between the configurations of the parallel linkage mechanisms, once the latter have been preset, is thus maintained.

The linkage mechanisms may be adjusted manually to vary the relative inclinations of the slats to suit different viewing positions. However, in the illustrated embodiment such adjustment is accomplished by pairs of electric motors which are disposed symmetrically with respect to the device. A pair of interconnected motors 56, 66 are mounted on the brackets 16, 19 and coupled to the bars 44, 55 for tilting the latter with respect to their respective horizontal axes, thereby altering the configuration of the grating to suit different viewing heights. Another pair of motors 57, 67 are coupled to the links 37, 38 of the mechanisms 33, 34 for rotating the links in pairs with respect to their vertical pivotal axes, thereby altering the configuration of the grating to suit different viewing distances. Of course, the interconnections of the linkages ensure that the pivotal movement of any one link is accompanied by the appropriate complementary movement of each corresponding link.

What I claim is:

1. A light masking device for improving image contrast on a video display screen under conditions of high ambient light, comprising a support frame adapted to be positioned in front of the screen and an optical filter supported thereby, the optical filter comprising a grating of spaced, elongated planar slats extending horizontally across the width of the screen, the slats being differentially inclined from the horizontal in the directions of their widths so as to converge on a horizontal line at a selected height and a selected distance from the screen, wherein the slats are pivotally connected to the support frame for pivotal movement about respective horizontal axes, the device further comprising linkage means interconnected with the slats for differentially adjusting the inclinations of the slats for selectively adjusting the position of said horizontal line on which the inclined slats converge.

2. A light masking device according to claim 1, wherein the slats are supported under tension in the direction of their length.

3. A light masking device according to claim 2, wherein the slats are of stainless steel and have substantially non-reflecting surfaces.

4. A light masking device according to claim 1, wherein said linkage means comprises a parallel linkage mechanism having a pair of upright links and a pair of end links extending transversely to the slats, and a plurality of differentially inclined bearing members extending between said upright links, each slat bearing on a respective one of said bearing members and being constrained thereby to lie in a plane determined by the inclination of said bearing member, said end links being mounted for pivotal movement about respective horizontal axes for differentially adjusting the inclinations of said bearing members with respect to the horizontal.

5. A light masking device according to claim 1, wherein said linkage means comprises a parallel linkage mechanism having a pair of upright links and a pair of end links extending transversely to the slats, and a plurality of differentially inclined bearing members extending between said upright links, each slat bearing on a respective one of said bearing members and being constrained thereby to lie in a plane determined by the inclination of said bearing member, said end links being mounted for pivotal movement about a common verti-

cal axis for varying the angle at which the bearing members traverse the slats.

6. A light masking device for improving image contrast on a video display screen under conditions of high ambient light, comprising:

a rectangular support frame adapted to be positioned in front of the screen, the support frame comprising a pair of upright end members and a pair of upper and lower cross members,

an optical filter supported by the support frame, the optical filter comprising a grating of spaced, elongated planar slats extending horizontally across the width of the frame, the slats being pivotally connected at their ends to said upright frame members for pivotal movement about respective horizontal axes,

the slats being differentially inclined from the horizontal in the directions of their widths so as to converge on a horizontal line at a selected height and a selected distance from the frame, and

adjustment means interconnected with the slats for differentially adjusting the inclinations of the slats for selectively adjusting the position of said horizontal line on which the inclined slats converge.

7. A light masking device according to claim 6, wherein said adjustment means comprises:

a pair of complementary parallel linkage mechanisms mounted on the support frame adjacent the ends thereof,

coupling means interconnecting said mechanisms and constraining said mechanisms for movement in unison,

each parallel linkage mechanism comprising a pair of upright links and a pair of end links extending transversely to the slats, and a plurality of differentially inclined bearing links extending between said upright links,

each slat bearing on a respective one of said bearing links of each parallel linkage mechanism and being constrained thereby to lie in a plane determined by the inclination thereof,

said end links of each parallel linkage mechanism being mounted for pivotal movement about respective horizontal axes for differentially adjusting the inclinations of said bearing links with respect to the horizontal,

and said end links of each parallel linkage mechanism being mounted for pivotal movement about a common vertical axis for selectively varying the angle at which the bearing links traverse the slats.

8. A light masking device according to claim 7, wherein the slats are supported under tension in the direction of their length.

9. A light masking device according to claim 8, wherein the slats are of stainless steel and have substantially non-reflecting surfaces.

10. A light masking device according to claim 7, wherein said adjustment means further comprises a first electric motor and a second electric motor mounted on the support, and first and second transmission means interconnecting said motors with said parallel linkage mechanisms for pivotally moving said mechanisms with respect to said horizontal and vertical pivotal axes, respectively.

11. A light masking device comprising a support frame defining an aperture and an optical filter supported thereby to intercept light falling on said aperture, the optical filter comprising a grating of spaced, elongated planar slats extending parallel to one another across the width of the aperture, the slats being differentially inclined in the directions of their widths so as to converge on a line extending parallel to the slats at a selected distance therefrom, wherein the slats are pivotally connected to the support frame for pivotal movement about respective longitudinal axes, the device further comprising linkage means interconnected with the slats for differentially adjusting the inclinations of the slats for selectively adjusting the position of said line on which the inclined slats converge.

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United States Patent [19] [11] 4,323,298
Brennan [45] Apr. 6, 1982

[54] WIDE FIELD OF VIEW GOGGLE SYSTEM

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[73] Assignee: Baird Corporation, Bedford, Mass.

[21] Appl. No.: 157,018

[22] Filed: Jun. 6, 1980

Related U.S. Application Data

[63] Continuation of Ser. No. 967,273, Dec. 7, 1978, abandoned.

[51] Int. Cl.[3] G02B 23/12; G02B 23/18

[52] U.S. Cl. 350/36; 350/72; 350/75

[58] Field of Search 350/36, 75, 76, 145, 350/146, 213 VT; 351/5; 2/430, 433, 437

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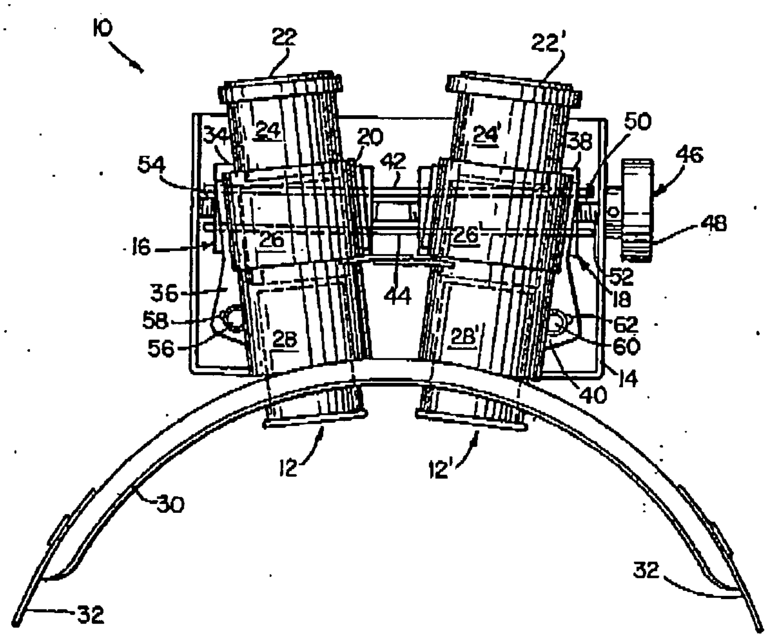
Primary Examiner—Jon W. Henry
Attorney, Agent, or Firm—Morse, Altman, Oates & Dacey

[57] ABSTRACT

A wide field of view goggle system with a pair of viewing channels that are mounted on a platform and are constrained for relative lateral and angular movement. Control mechanisms are provided for adjustment of the interpupillary distance between the channels and the angular position of the channels relative to one another. An instantaneous wide field of view is provided by relative angular orientation of the viewing channels in a common, overlapping field of view.

2 Claims, 5 Drawing Figures



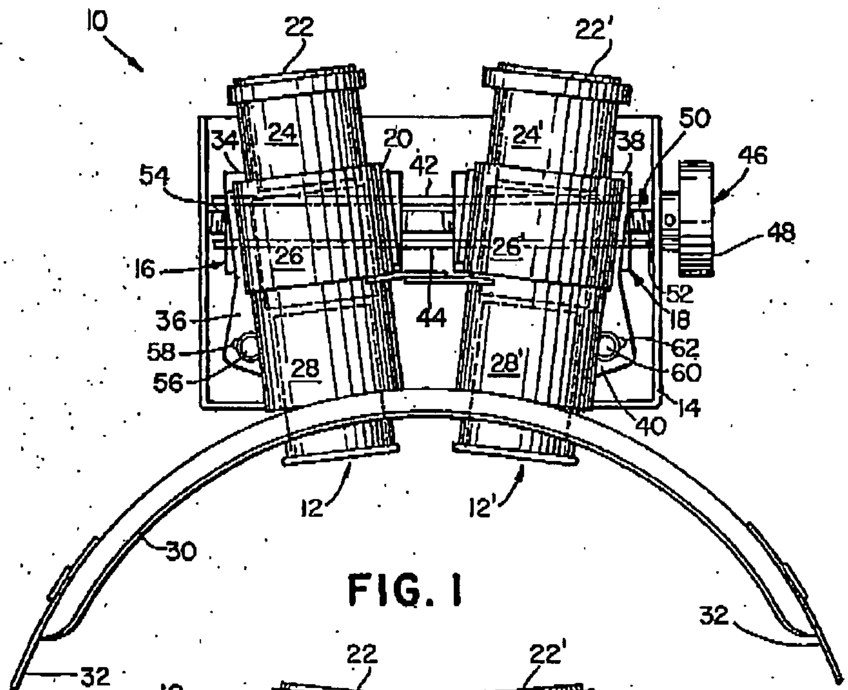

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FIG. 1

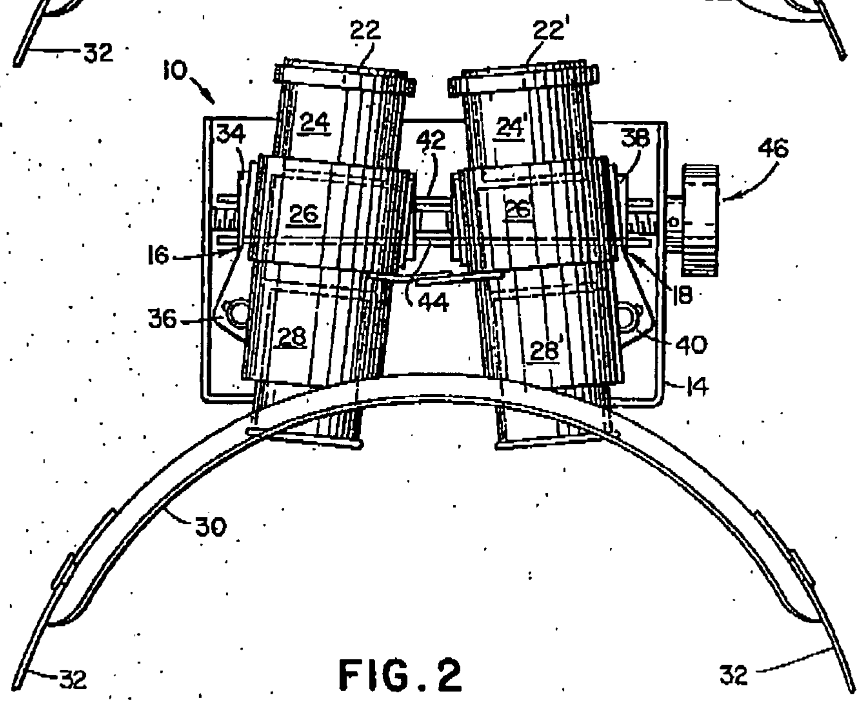
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FIG. 2

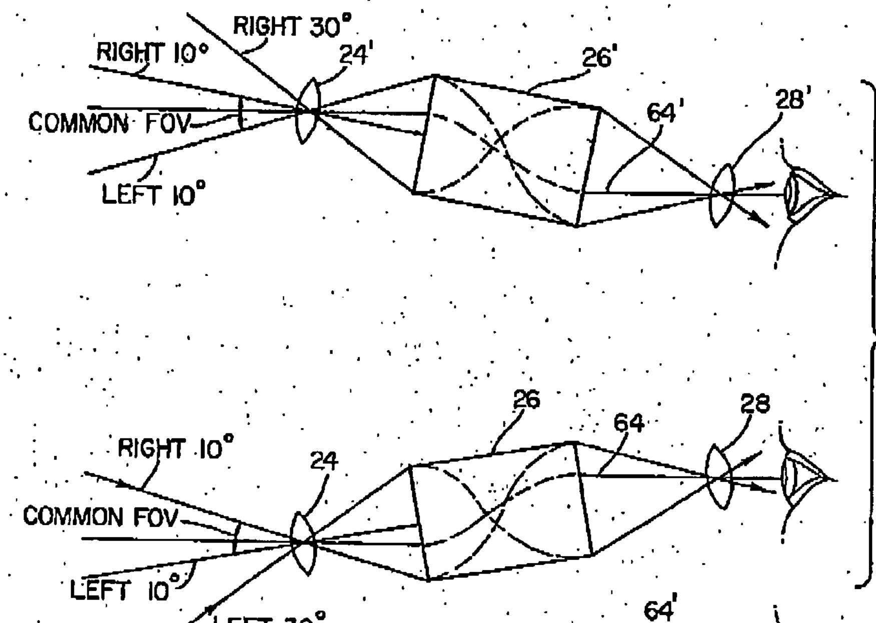

FIG.3

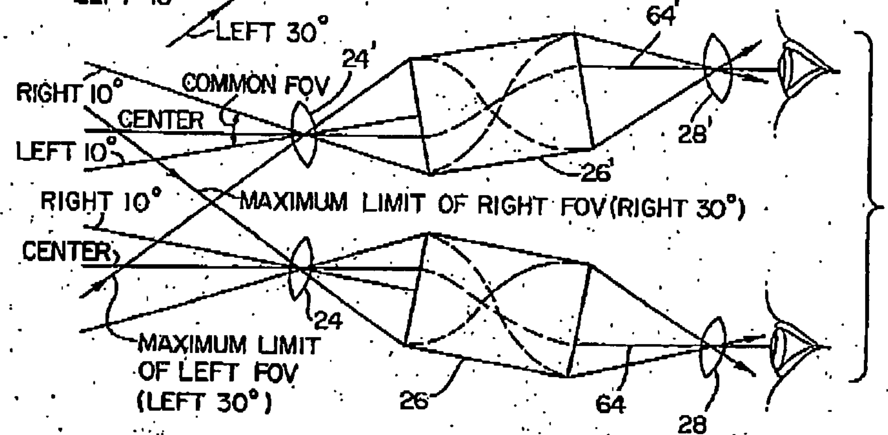

FIG.4

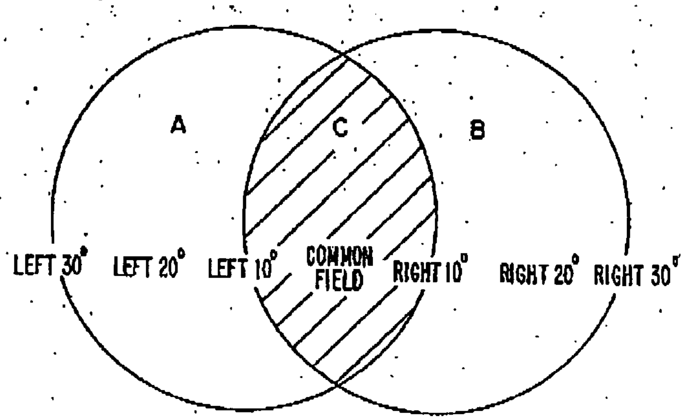

FIG.5

WIDE FIELD OF VIEW GOGGLE SYSTEM

This is a continuation, of application Ser. No. 967,273 filed on Dec. 7, 1978 now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to viewing systems and, more particularly, is directed towards a wide field of view goggle system.

2. Description of the Prior Art

Generally, night vision goggles include a pair of viewing channels, each channel having an objective lens, an image intensifier tube and an eyepiece. The center of one channel's axis is oriented parallel to the center of the other channel's axis so that the system's field of view is determined essentially by the field of an individual channel. The increased angular field of existing goggles, due to the distance between the axis of each channel, is not significant. In present goggle systems with a fixed diameter (area) intensifier tube, the field of view and the resolution of the system are directly related.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a goggle system with an instantaneous wide field of view.

Another object of the invention is to provide a method for obtaining an instantaneous wide field of view in a goggle system by angular orientation of a pair of relatively movable narrow viewing channels.

A further object of the invention is to provide a night vision goggle system with an instantaneous wide field of view. The system is characterized by a pair of relatively movable viewing channels that are mounted to a housing. The channels are constrained in such a manner that both the interpupillary distance and the angular position of the channels are adjustable relative to one another. The relative angular orientation of the viewing channels in a common plane provides a common, overlapping field of view, the total instantaneous field being equal to the sum of the individual fields minus the angle between the fields of view.

Other objects of the present invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus, together with its parts, elements and interrelationships, that are exemplified in the following disclosure, the scope of which will be indicated in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A fuller understanding of the nature and objects of the present invention will become apparent upon consideration of the following detailed description taken in connection with the accompanying drawings, wherein:

FIG. 1 is a plan view of a goggle system having a diverging optical channel configuration;

FIG. 2 is a plan view of the goggle system in a converging optical channel configuration;

FIG. 3 is a chief ray plot of the diverging configuration of FIG. 1;

FIG. 4 is a chief ray plot of the converging configuration of FIG. 2; and

FIG. 5 is a graphical plot of the coverage of each eye in both configurations.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, particularly FIG. 1, there is shown an optical system 10, for example a goggle system, particularly a night vision goggle system, having a pair of optical channels 12 and 12' that are mounted to a frame or platform 14 by means of channel supports 16 and 18, respectively. Optical channels 12 and 12' are identical optical channels and therefore, corresponding elements of optical channels 12 and 12' are denoted by like reference characters and are distinguished by prime notations. Channel 12, for example an image intensifier unity power channel, includes a housing 20 with an iris 22, an objective lens 24, an image intensifier tube 26 and an eyepiece 28. In the preferred embodiment, objective lens 24 is a f/1, 16.5 mm format objective lens with a focal adjusting thread; image intensifier tube 26 is a 12 mm format image inverting intensifier tube; and eyepiece 28 is a 16.5 mm focal length eyepiece with a diopter adjustment and a field of view of forty degrees. A facial hood 30 having straps 32 is adjustable to fit over the top and around the rear of a user's head. Facial hood 30 holds platform 14 which extends outwardly from the user's forehead.

Optical channels 12 and 12' are laterally movable relative to each other for interpupillary adjustment and are angularly movable for adjustment of the angular orientation of the optical axis of each channel relative to one another. Channel support 16 includes a base 34 and a body 36, and channel support 18 includes a base 38 and a body 40. Platform 14 is provided with a pair of guide rails 42 and 44 which are disposed in paths that are in space parallel relationship to a plane in which the user's eyes are disposed. Bases 34 and 38 are constrained for lateral movement by guide rails 42 and 44. The distance between channel supports 16 and 18 is controlled by an adjusting member 46 with an enlarged head or knob 48 and a threaded shaft 50 having right hand threads 52 and left hand threads 54. When knob 48 is turned in one direction, bases 34 and 38 move towards each other on guide rails 42 and 44. When knob 48 is turned in the opposite direction, bases 34 and 38 move away from each other on guide rails 42 and 44. Since optical channel 12 is carried on base 34 and optical channel 12' is carried on base 38, the optical channels laterally move either towards or away from each other in a common plane depending upon the direction in which knob 48 is rotated. From the foregoing, it will be apparent that adjusting member 46 constitutes an interpupillary adjusting device for varying the interpupillary distance between optical channels 12 and 12'.

Optical channel 12 is carried on body 36 which is pivotally mounted to base 34 and optical channel 12' is carried on body 40 which is pivotally mounted to base 38. A locking device 56, for example a thumb screw, which is received in a slot 58 formed in body 36, is turned into base 34 for captively holding channel 12 in a fixed angular position. When thumb screw 56 is loosened, body 36 is movable in a arcuate path for angularly positioning channel 12. In a similar manner, a locking device 60, for example a thumb screw, which is received in a slot 62 in body 40, is turned into base 38 for captively holding channel 12' in a fixed angular position. When thumb screw 60 is loosened, body 40 is movable in arcuate path for angularly positioning chanel 12'. That is, the relative angular position of optical channels 12 and 12' with respect to one another is vari-

able. FIG. 1 shows goggle system 10 in a diverging optical channel configuration and FIG. 2 shows goggle system 10 in a converging optical channel configuration.

In the illustrated embodiment of FIGS. 3 and 4, the line of sight of each optical channel 12 and 12' is adjusted and locked so that the angle therebetween is twenty degrees. Interpupillary adjusting mechanism 46 is adjusted so that the center of the optical axis 64 and 64' from each eyepiece 28, 28', respectively, intersects the user's eye. The center-to-center eye distance is in the range of fifty-five mm to seventy two mm. Therefore, the user's left and right eyes have twenty degrees common field when looking straight ahead. The total field of view (FOV) seen by both eyes is sixty degrees. FIG. 5 illustrates graphically that each eye has a field of view of forty degrees. Reference character A is the left field and reference character B is the right field when the channels are in the diverging configuration of FIG. 1 and A is the right field and B is the left field when the channels are in the converging configuration of FIG. 2, reference character C denotes the common field to both eyes. The focus of each objective lens 24, 24' is set for normal operating distance and the diopter adjustment of each eyepiece 28, 28' is set for user comfort.

From the foregoing, it will be apparent that the present invention features an arrangement of two obliquely disposed optical channels which provide an increase in the field of view while achieving the same angular resolution as if the two channels were arranged parallel to each other. The optical channels are constrained for both relative lateral movement and relative angular movement in a common plane, the final position of the channels being such that the optical axis of one channel intersects the optical axis of the other channel. An instantaneous wide field of view is provided by orienting each individual narrow optical channel 12, 12' in a common plane at an angle to each other such that there is a common, overlapping field of view. The total instantaneous field of view is equal to the sum of the individual field of view of each optical channel 12, 12' minus the angle between the fields of view. The total field of view of the left channel can be seen by the left eye and the total field of view of the right channel can be seen by the right eye. The increased field of view provides increased performance characteristics for the user because the image presented has as much angular resolution over a wider angular field as goggles equipped with the same tube operated in a parallel mode with the same angular field in each channel. Goggle system 10 has a better angular resolution over a wide field than a conventional goggle system with a totally common field of view and equipped with the same format and with lenses which would result in as wide a field of view.

Since certain changes may be made in the foregoing disclosure without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description and depicted in the accompanying drawings be construed in an illustrative and not in a limiting sense.

What is claimed is:

1. An optical viewing device in the form of a night vision goggle system and having a wide field of view, said system comprising:

(a) a frame;

(b) adjusting means mounted to said frame and including a first channel support and a second channel support, said first channel support having a first base and a first body, said second channel support having a second base and a second body, said first base and said second base constrained to said frame for relative lateral movement, said first body mounted to said first base for pivoting movement relative thereto, said second body mounted to said second base for pivoting movement relative thereto, first means for controlling said relative lateral movement of said first base and said second base to effect interpupillary adjustment over an interpupillary distance of from about fifty-five mm. to about seventy-two mm., and second means for controlling said pivoting movement of said first body and said second body, said second means being fixed once said pivoting movement of said first and second body relative to one another has been effected;

(c) a first optical channel with a narrow field of view and having a first optical axis, said first optical channel mounted to said first channel support of said adjusting means;

(d) a second optical channel with a narrow field of view and having a second optical axis, said second optical channel mounted to said second channel support of said adjusting means, the angular magnitude of said field of view of said first optical channel being the same as the angular magnitude of said field of view of said second optical channel;

(e) said first optical axis and said second optical axis constrained for relative angular movement with respect to one another in a common plane to provide an increased wide field of view characterized by having a common overlap and an angular resolution equal to that provided by said field of view of said first and second optical channels, said first optical axis and said second optical axis intersecting one another at an angle of about twenty degrees.

2. The optical viewing device as claimed in claim 1 wherein each said optical channel includes an objective lens, image intensifier means and an eyepiece, said viewing device having unity magnification, and wherein said first means includes a pair of guide rails and an adjusting member having a head and a threaded shaft operatively mounted within said pair of guide rails, said shaft provided with left and right hand threads for said first and second bases respectively, and said second means includes a slot formed respectively in said first and second body and a fastening member operatively mounted within said slot, whereby said pivoting movement of said first and second body with respect to said frame is first selected and then fixed.

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